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USSR Report

SCIENCE AND TECHNOLOGY POLICY

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USSR REPORT

SCIENCE AND TECHNOLOGY POLICY

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ORGANIZATION, PLANNING AND COORDINATION

FORECASTING SCIENTIFIC AND TECHNICAL PROGRESS

Moscow EKONOMICHESKIYE PROBLEMY NAUCHNO-TEKHNICHESKOGO PROGRESSA in Russian 1984 (signed to press 28 Dec 83) pp 109-119

[Section 3, Chapter 3 from book "Economic Problems of Scientific and Technical Progress," 3rd, revised and enlarged edition, edited by Doctor of Economic Sciences Professor G. A. Krayukhin, Ekonomika, 50,000 copies, 296 pages]

[Text] 3. Scientific and Technical Forecasting

The Essence and Basic Tasks of Scientific and Technical Forecasting

The system of the management of scientific and technical progress, which exists in the USSR, envisages the making of special calculations, which are connected with the formulation of scientific and technical forecasts.

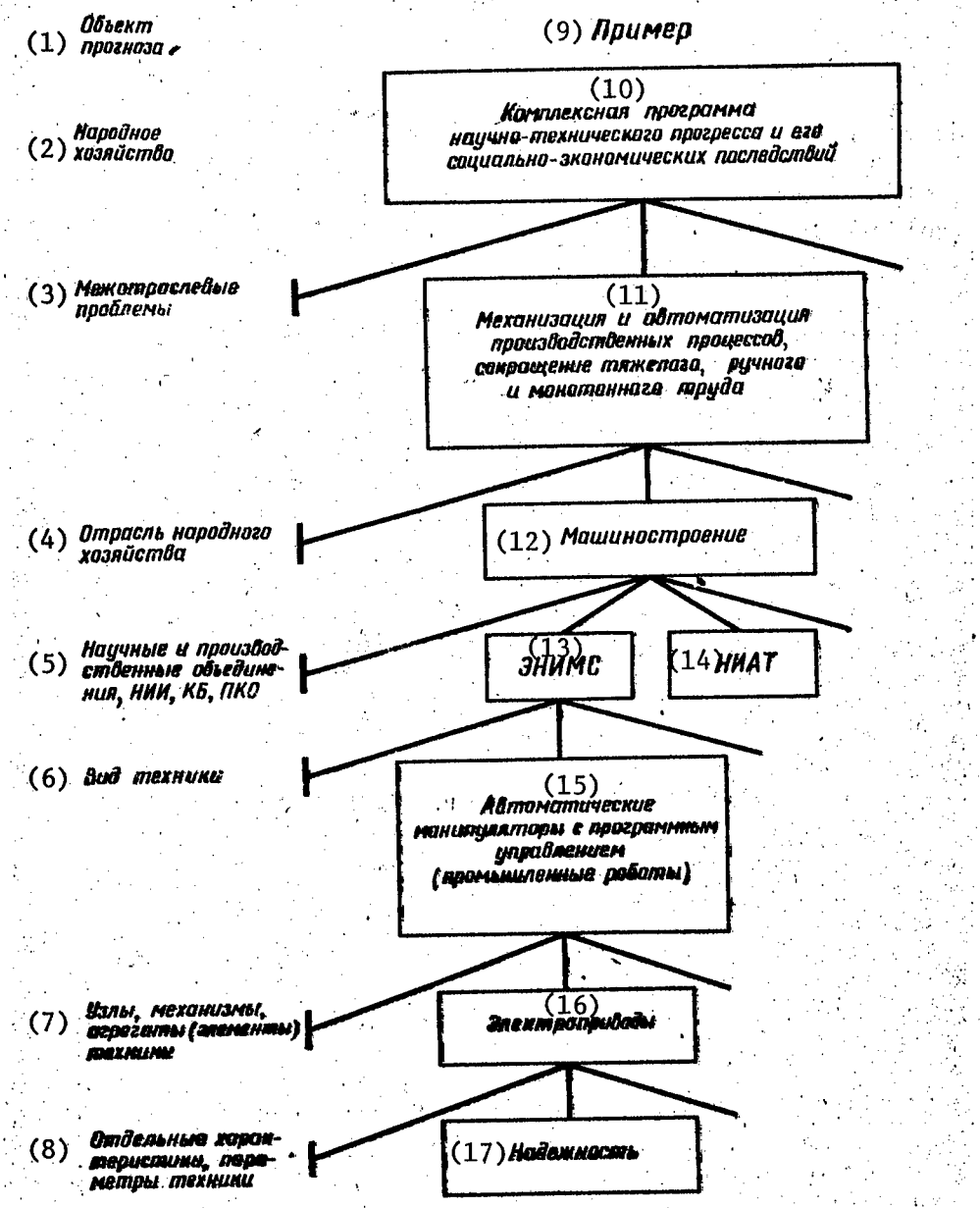
The basic function of scientific and technical forecasting consists in the search for the most effective means of developing the objects being studied on the basis of a comprehensive retrospective analysis and the study of the trends of their change. In the system of the management of scientific and technical progress the forecast ensures the accomplishment of the following most important tasks: the determination of the possible goals and most important directions of the development of the object being forecast; the appraisal of the social and economic consequences of the implementation of each of the possible versions of the development of the objects being forecast; the determination of the measures, which are necessary for the support of each of the possible versions of the development of the objects being forecast; the appraisal of the resources which are necessary for the implementation of the outlined programs of measures.

The forecast is a scientific hypothesis, a well-founded search for possible means of accomplishing tasks, including the scientific and technical development of individual systems. The plan as a directive of development, which records specific sound goals and outlines measures, the specific times and conditions of their fulfillment, is with respect to the forecast the final stage of the process of making decisions.

The need for the formulation of various types of scientific and technical forecasts is predetermined by the complexity of science and technology as

objects of management. Forecasts differ according to the nature of the object, the content of the prognostic statement, the period of forecasting, the scale and degree of comprehensiveness, the level of formulation and so on.

Diagram 2. Interconnection of Individual Forecasts in the Overall System of Forecasting



[Key on following page]

Key:

1. Object of forecast
2. National economy
3. Intersectorial problems
4. Sector of national economy
5. Scientific and production associations, scientific research institutes, design bureaus, planning and design organizations
6. Type of equipment
7. Assemblies, mechanisms, units (components) of equipment
8. Individual characteristics, parameters of equipment
9. Example
10. Comprehensive program of scientific and technical progress and its socioeconomic consequences
11. Mechanization and automation of production processes, decrease of difficult, manual and monotonous labor
12. Machine building
13. Experimental Scientific Research Institute of Metal-Cutting Machine Tools
14. Scientific Research Institute of Aviation Technology
15. Automatic manipulators with programmed control (industrial robots)
16. Electric drives
17. Reliability

The system of forecasting, which exists in the USSR, envisages the formulation of scientific and technical forecasts at all levels of the management of scientific and technical progress in the country. Depending on the level of formulation the object of the forecast is differentiated and is distinguished first of all by the breadth of the thematic framework. With allowance made for the breadth of the thematic framework and the level of formulation there are distinguished the forecasts: of the scientific and technical development of the country and regions, the development of individual trends of science and technology, as well as the solution of sectorial scientific and technical problems; sectorial scientific and technical forecasts, forecasts of the development of independent scientific research institutes, design bureaus and scientific production associations, the development of individual types of equipment, the improvement of the components of equipment (assemblies, units, machanisms and so forth) and, finally, of the changes of individual parameters and characteristics of the equipment being planned. They are all interconnected by the relations of subordination and form a hierarchical system of forecasting, which ensures the fundamental combination of forecasting activity at different levels of management and with respect to all the directions and areas of science and technology. The approximate interconnection of the individual types of forecasts in the overall system of forecasting is cited in Diagram 2.

The formulation of three types of forecasts: short-term, which cover a period from 1 to 5 years; intermediate-term, which are intended for a period of up to 15 years; and long-term, which are intended for 15 years and more, is envisaged by the statutes in effect in our country for the purpose of the thorough substantiation of the plans of the development of science and technology, which are being drafted.

When determining the optimum period of scientific and technical forecasting the nature of the specific object of forecasting, as well as the overall rate of scientific and technical progress in the given field of knowledge should be taken into account. The more narrow the thematic framework of the forecast

being formulated is, the shorter the period of forecasting should be. In new, rapidly developing fields of science and technology the periods of forecasting are being shortened, while the forecasts themselves are updated more often than in traditional fields.

The Methods of Scientific and Technical Forecasting

The diversity of the types of scientific and technical forecasts and of the problems, which are solved by means of them in the system of the management of science and technology, requires the use of various systems and methods of the construction of the forecasts themselves. Every forecast emerges as a result of the multistage process of the obtaining of the necessary information, its processing by means of special techniques and the evaluation of the reliability of the obtained results. The set proper of these three components also characterizes the specific method of formulating the scientific and technical forecast. The choice of the bearers of information, the method of obtaining it, the sequence and content of the making of special calculations for the purpose of the objective evaluation of the prospects of the development of the object being studied depend on which specific data are necessary for the formulation of the forecast.

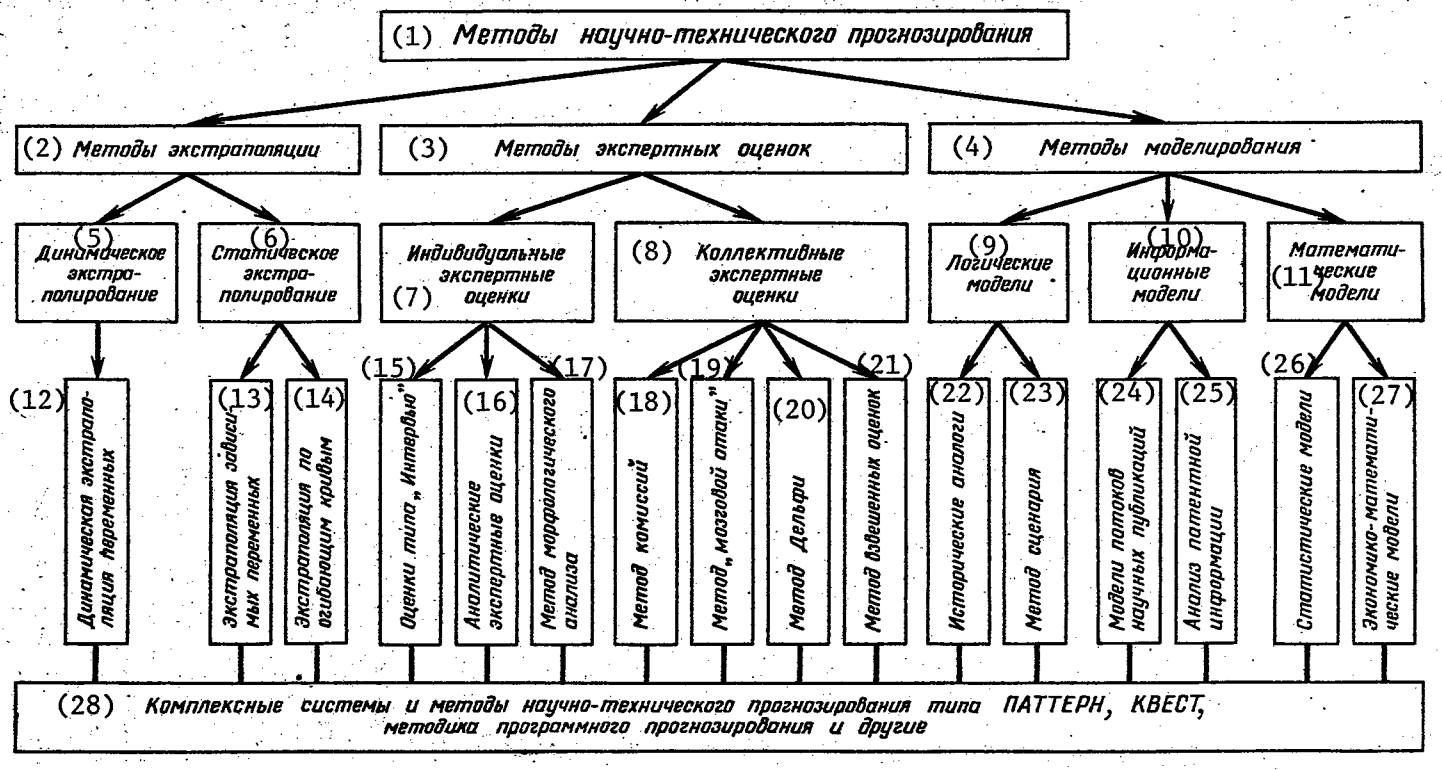
Domestic and foreign practice has more than 130 different methods of formulating the forecast. It is arbitrarily possible to reduce all the diversity of the procedural techniques of scientific and technical forecasting to three most important groups: forecasting on the basis of extrapolations, expert methods of forecasting and methods of modeling (Diagram 3).

The methods of extrapolation are used most often when forecasting science and technology. Their essence consists in the fact that, by analyzing the change of individual paramters of the equipment being developed in the past and studying the factors, which are responsible for these changes, it is possible to draw conclusions about the laws of development and the means of the improvement of equipment in the future.

In scientific and technical forecasting it is customary to distinguish two types of problems which are solved by the methods of extrapolation: the problems of dynamic and static analysis.

In the dynamic problem the time factor acts as the main and only factor of development. In this case the forecast of the development of a scientific trend or a type of equipment is drawn up on the basis of the careful analysis of time series, which reflect the change of one or another parameter being forecast in time. For example, the change in time of such parameters as the power, speed, reliability, resolution, weight-size characteristics and others is analyzed.

Diagram 3. General Diagram of the Classification of Used Methods and Systems of Forecasting



[Key on following page]

Key:

1. Methods of scientific and technical forecasting
2. Methods of extrapolation
3. Methods of expert appraisals
4. Methods of modeling
5. Dynamic extrapolation
6. Static extrapolation
7. Individual expert appraisals
8. Collective expert appraisals
9. Logical models
10. Information models
11. Mathematical models
12. Dynamic extrapolation of variables
13. Extrapolation of independent variables
14. Extrapolation by envelope curves
15. Appraisals like the "interview"
16. Analytical expert appraisals
17. Method of morphological analysis
18. Method of commissions
19. "Brainstorming" method
20. Delphi method
21. Method of weighted appraisals
22. Historical analogues
23. Scenario method
24. Models of flows of scientific information
25. Analysis of patent information
26. Statistical models
27. Mathematical economic models
28. Comprehensive systems and methods of scientific and technical forecasting like PATTERN, KVEST, the method of programmed forecasting and others

Most often there are used for the forecasting of technical parameters functions like

$$Y(t) = K_0 + \sum_{i=1}^{p} K_i t^i,$$

where $Y(t)$ is the parameter being forecast; t^i is the year in the period being forecast; K_0 and K_i are estimated coefficients of the approximating function ($i=1, 2, \ldots, p$).

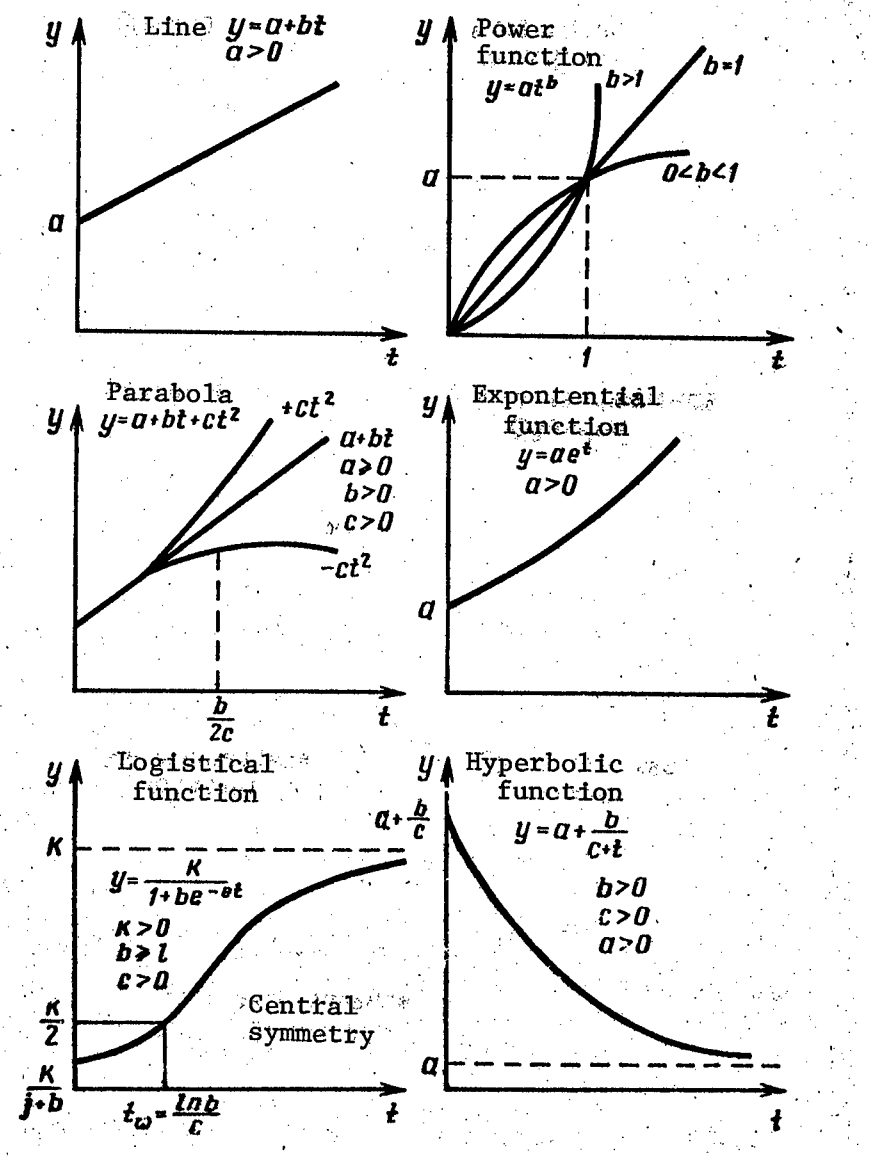
See the general appearance of the functions used most often in forecasting in Figure 1.

The direct forecasting of the parameters of the development of science and technology by the method of extrapolation is carried out in accordance with the calculated approximating functions. For this they choose the required value of the argument of the period of forecasting, which lies outside the empirical data, insert it in the obtained equation and calculate the anticipated value of the parameter being forecast in the future.

In the analytical expression of the development of the object (parameter) being forecast the time factor is regarded as an independent variable, while the values of the parameters act as a function of this variable. However, the development of science and technology and the corresponding changes of the parameters being forecast depend not on how many years have passed since the initial moment, but on what factors influenced its development, in what direction and with what intensity. The change of the parameters in time appears as the result of the action of many factors. Therefore it is extremely important in the process of formulating the forecast to study the dependences of the main parameters being forecast on the factors, which influence their

development. In this connection, as a rule, the second, static problem of the extrapolation of trends also arises.

Figure 1. The General Appearance of the Functions Used Most Often in Forecasting

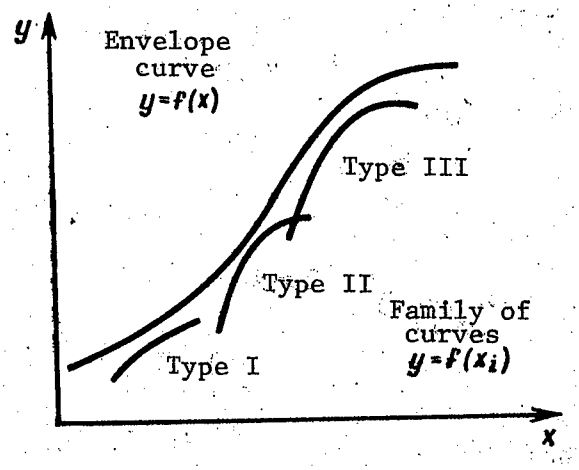


The forecasting of the parameters according to the factors, which influence their development, is carried out on the basis of the methods of correlation and regression analysis.

The forecasting of the values of the labor intensiveness of the development of machines and units in accordance with the set of design, technological and operational factors is a typical example of the extrapolation of the parameters of equipment being designed by the methods of correlation and regression analysis.

The extrapolation of trends presumes the similarity of the conditions, functions and principles of the action of the objects being forecast in the past and the future. A rapid interchange and the change of the principles of the action of the equipment being developed have a large influence on the quality of extrapolation forecasts. The method of the extrapolation of variables over envelope curves is used for the forecasting of rapidly evolving processes and objects. The content of this method consists in the construction of an envelope curve, which approximately reflects the overall trend of change of the parameter being forecast in accordance with the data which are characteristic of various classes (or generations) of objects of a single functional purpose. Forecasting in accordance with an envelope curve reduces to the extrapolation of the point or interval values of the parameter for one period or another (the diagram of the construction of an envelope curve on the basis of a family of curves, which are characteristic of items of a single class, is presented in Figure 2).

Figure 2. The Construction of an Envelope Curve on the Basis of a Family of Curves



The extrapolation of trends belongs to the quantitative methods of forecasting. The methods of expert appraisals are used extensively for the forecasting of qualitative characteristics, as well as objects, the development of which does not lend itself to formalization and statistical modeling.

The essence of the expert methods of scientific and technical forecasting consists in the fact that a conclusion about the means of the development of science and technology and the long-range trends of scientific research and development is drawn on the basis of the a priori appraisals of a highly skilled specialist or group of specialists.

Subject to the form of work with experts the individual and collective methods of appraisal are distinguished.

The individual methods of appraisal envisage personal work with each expert and the obtaining of the private opinion of the expert, which has not been coordinated in advanced with the others. The form of obtaining expert appraisals can be different.

Frequently the survey in case of the individual appraisal is conducted by the interview method with direct interaction with the expert. Here the expert is guided for the most part only by a priori notions about the object being forecast. Most often the experts are surveyed by correspondence by the timely sending to them of prepared questionnaires (analytical expert appraisals). In this case the individual expert appraisals are of an analytical nature, since the expert has the opportunity to receive and analyze all the necessary information on the experience of the development and the interrelations of the object being forecast. But here, too, the appraisal of the expert appears in most cases as the product of his intuitive thinking.

Among the methods of individual expert appraisal the method of morphological analysis merits special attention. It envisages a strict procedure of the analysis and appraisal of the possible versions of the solution of complicated, multilevel technical problems. The essence of this procedure consists in the breaking up of the problem into individual components, in the determination of their possible states in the future and the sequential examination of all possible combinations of the anticipated states with respect to all the components of the problem.

Individual expert appraisals are rarely used as an independent method for the formulation of a forecast. For the purpose of increasing the soundness of the forecast statements the individual appraisals of several components most often are compared and combined, forming a collective expert appraisal. It is customary to call the methods, which envisage such a combination and comparison of individual appraisals, a collective, or group, appraisal. As a rule, its use is accompanied by an increase of the accuracy and depth of the forecasts being formulated. At the same time the collective one-sidedness of opinions, which is due to the similarity of culture and traditions, the influence of the dominant trend in the development of technology and so forth, frequently affects the group opinion. Therefore the collective opinion of the experts can be of a compromise nature to the detriment of the obtaining of a valuable original solution. The listed shortcomings of collective appraisal are most characteristic of the method which has received the name "the method of commissions."

The content of the diverse methods of collective expert appraisals reduces mainly to using all the merits of the group appraisal, while reducing its

shortcomings to a minimum. This is accomplished first of all by the creation of conditions which are conducive to the formation of objective appraisals.

The "brainstorming" method is one of the most interesting attempts to create such conditions. The essence of this procedure consists in the fact that the work of the group of experts breaks down into two stages: at the first ideas and new technical solutions are generated, at the second the practical appraisal of the obtained information and the selection of efficient solutions are carried out. The effectiveness of such an "attack," which is conducted with allowance made for specific rules, is evaluated according to the number of ideas which were established in the process of discussing the problem.

In contrast to the method of commissions and "brainstorming" the procedure of the Delphi method envisages the total isolation of the experts and the anonymity of their opinions. The survey is conducted in the form of questionnaires for the ascertainment of the relative importance and the time of occurrence of the anticipated events in the area being forecast. The group decision is made not in accordance with the opinion of the majority, but on the basis of the statistical processing of the individual appraisals with allowance made for the degree of agreement of the opinions of the experts, which is characterized by the relative magnitude of the swing of the individual appraisals.

A number of methods reflect the standard approach to the formulation of scientific and technical forecasts. Given such an approach the prospects of the development of science and technology are determined on the basis of a preset goal. In this case the task of the forecast is to form a structure of interconnected components which ensure the unconditional and most efficient achievement of the set goal. The structure of the interconnected components forms a hierarchical system, the graphical representation of which is called "a tree of goals." Components, which reveal the content or the means of solution of the problems of the higher level, are located at each level of the "tree of goals." The method of weighted appraisals can serve as an example of the standard approach to the formulation of the forecast of the development of science and technology at the level of the sector. Its content consists in the construction of a "tree of goals," which consists of five levels: the overall goals of scientific and technical progress in the sector, the basic tasks of the development of scientific research and development, the basic trends of scientific and technical progress, the main scientific and technical problems and the most important themes of scientific research and development. The components of each level are evaluated in terms of a set of weighted appraisals. The components of the equation below act as the criteria of the appraisals:

$$K_{\nu}^{i+1} = \sum_{j=1}^{n} K_j^i \cdot K_{j\nu}^{i+1}; \quad \sum K_{j\nu}^{i+1} = 1.0; \sum K_j^i = 1.0,$$

where K_{ν}^{i+1} is the weight coefficient of the component with the ordinal number ν of level (i+1), which was estimated with respect to component j of level i.

The sequential examination of the components of all levels makes it possible to ensure the consistency of the goals and the means of solving the problems of the scientific and technical development of the sector with the general tasks of the social and economic development of the national economy and state policy in the area of technical progress.

The modeling of the processes of the development of science and technology is regarded as one of the most promising approaches to the formulation of forecasts. The logical, information and mathematical models of forecasting differ in the nature of the models being used.

Logical modeling includes the careful study of the internal logic of the development of the object being forecast and the elaboration on this basis of the corresponding historical models--patterns. Historical analogues are then used when resolving specific situations and problems of the development of the object being forecast.

The methods of constructing various information models are of practical interest. Thus, for example, the statistical analysis of the number of scientific publications, scientific journals, the frequency of the use of printed works and so forth makes it possible to judge the rate and nature of the development of scientific subjects, some types of equipment or others.

At present methods of scientific and technical forecasting, which are based on the analysis of the information files which are contained in the applications for inventions and in issued patent documents, have been formulated and are being used. The individual approaches envisage the comprehensive evaluation of the engineering and technical significance and economic advisability of the use of the patents being analyzed and the determination of the promise of various technical solutions. In many countries the use of patent information determines the technical policy of firms and associations.

Mathematical models of forecasting are the most universal and quite strict methods of the analysis of the trends of the development of technology. They make it possible to give a quantitative description of the dynamics of the development of real objects of forecasting and to study the nature and the directions of the influence on their change of various factors. The methods of statistical analysis, the study of production functions and dynamic programming are used especially frequently for the modeling of the processes of scientific and technical development.

It is necessary to specially note that none of the actually existing forecasts is formulated on the basis of just one method. The creation of a forecast of the development of a specific type of technology is a complex study, in the process of the fulfillment of which the most diverse methods and approaches, which form combined systems of forecasting, are used.

In USSR practice the comprehensive approach to the formulation of forecasts of the development of science and technology found reflection in the method of programmed forecasting, which was endorsed by the USSR State Committee for Science and Technology.

The Organization of Scientific and Technical Forecasting in the USSR

The system of the forecasting of the development of science and technology includes the development of forecasts on the most important scientific and technical problems of the development of the national economy, sectorial and subsectorial problems, as well as forecasts of the development of individual types of technology. The USSR State Committee for Science and Technology carries out the coordination of the work on methodological and organizational questions of scientific and technical forecasting. For the purpose of ensuring the procedural unity of the forecasts being formulated the USSR State Committee for Science and Technology and the Presidium of the USSR Academy of Sciences prepared and approved the Procedure of the Formulation of Scientific and Technical Forecasts, which establishes the basic procedural and organizational principles and the required demands on the compilation of scientific and technical forecasts.[1]

One of the most important problems of the improvement of planning at sectorial scientific research institutes and design bureaus consists in increasing the level of soundness of the thematic plans of scientific research and development on the basis of the use of the data of scientific and technical forecasts.

The practical solution of this problem determines the leading role of sectorial scientific research institutes and design bureaus in the development of scientific and technical forecasting in the sectors of industry. It is possible to distinguish three types of problems which are solved by sectorial scientific research institutes and design bureaus in the system of scientific and technical forecasting:

the creation, build-up and updating of the information base of forecasting;

the procedural support of the formulation of scientific and technical forecasts;

the organizational support and coordination of the operations on the formulation of scientific and technical forecasts.

The information base of forecasting at scientific research institutes and design bureaus includes the data on the structure and extents of the need of the national economy for developments, information on previously completed developments, detailed data on the state of domestic developments in the area being studied, information on foreign achievements, patent information and information on the conditions of the foreign market and so forth.

The organizational support of the system of forecasting at scientific research institutes and design bureaus envisages the establishment of a service of scientific and technical forecasting, the elaboration of schedules of the fulfillment of forecasting research, the establishment and organization of the work of expert commissions, the preparation of computer data processing

1. Decree No 499/66 of the USSR State Committee for Science and Technology and the Presidium of the USSR Academy of Sciences of 30 December 1969.

programs and the organization of the use of computers for the analysis of the trends of the development of science and technology, the duplication of the results of forecasting and the assurance of their use in the process of formulating the thematic plans of scientific research institutes and design bureaus.

Discussion Questions

1. What most important directions of the improvement of the planning of the development of science and technology were specified by the 26th CPSU Congress?

2. What types of plans in the area of science and technology are drafted in the national economy and sectors of industry?

3. The basic content of the goal program methods of the development of science and technology. What types of programs are being formulated during the 11th Five-Year Plan?

4. What functions do scientific and technical forecasts perform in the system of the management of scientific and technical progress?

5. How is the formulation of forecasts organized at sectorial scientific research institutes and design bureaus?

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ORGANIZATION, PLANNING AND COORDINATION

FORECASTING OF BELORUSSIAN SCIENTIFIC, TECHNICAL PROGRESS

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 85 pp 12-14

[Article by Candidate of Technical Sciences G. Nesvetaylov, chief of the Sector of the Science of Science of the Institute of Economics of the Belorussian SSR Academy of Sciences, and Candidate of Economic Sciences V. Osipov, senior scientific associate of the Institute of Economics of the Belorussian SSR Academy of Sciences: "Foresee in Order to Act"]

[Text] An important tool of the theoretical and practical solution of the problems of scientific and technical progress is its comprehensive socioeconomic forecasting. The first practical attempt at such forecasting on a broad scale was made in our republic 13 year ago. At that time a report-forecast on the most important socioeconomic, scientific and technical problems of the development of the national economy of the Belorussian SSR for 1976-1990 was prepared. However, this work was performed without the proper procedural support and without preliminary scientific research, which decreased its practical utility.

During the past and current five-year plans much was done in the republic for the transition from individual forecasts by the methods of temporary commissions and conferences to permanent systematic forecasting and analytical activity, which is based on the use of a special procedural system. Candidate of Technical Sciences G. Nesvetaylov, chief of the Sector of the Science of Science of the Institute of Economics of the Belorussian SSR Academy of Sciences, and Candidate of Economic Sciences V. Osipov, a senior scientific associate of this institute, tell about the experience of this work and the search for new means and forms of the planning of scientific and technical progress and its management.

A scientific council for the problems of scientific, technical and socioeconomic forecasting of the Belorussian SSR Academy of Sciences and the Belorussian SSR State Planning Committee has been set up in the republic. The subdivisions of the science of science, which have been formed at the

Belorussian SSR Academy of Sciences, the Belorussian SSR State Planning Committee, the Belorussian SSR Ministry of Higher and Secondary Specialized Education, the Belorussian SSR Ministry of Health and scientific production associations, are elaborating the problems of the economics, organization and long-range planning of research. The Comprehensive Program of Scientific and Technical Progress to 2005, of which the consolidated section--the basic directions of the development of science and the scientific potential of the republic--is an important part, was formulated under the scientific methods supervision of the Institute of Economics of the Belorussian SSR Academy of Sciences. The priority directions of research, of its resource supply and practical use in the national economy for the immediate future are specified in it. Many scientific institutions and higher educational institutions of the republic and scientific councils of the Belorussian SSR Academy of Sciences took an active part in the preparation of the section. The creation of the optimum organizational and economic conditions of the development of science and its interaction with production was regarded as the most important goal.

The scientific and technical potential of Belorussia in recent decades has developed very dynamically. Although the share of the republic in the USSR population has decreased, the proportion of Belorussian scientists in the total number of scientific personnel, candidates and doctors of sciences of the country has increased noticeably.

Authoritative schools in the area of algebra and differential equations, computer software, theoretical physics, optics and spectroscopy, microelectronics and radio electronics, materials technology, heat and mass exchange, the physiology of the vegetative nervous system, genetics and linguistics have been formed in Belorussia. The scientific institutions and organizations of the republic are confidently changing over to the intensive means of development, as a result of which the productivity of research and development is increasing more rapidly than the expenditures on their performance. Thus, back during the last five-year plan the average annual growth rate of the economic impact from the use of the results of work of the Belorussian SSR Academy of Sciences came to about 30 percent, while the volume of fulfilled economic contracts increased by 11 percent and the number of workers at the academy increased by only 3.3 percent a year. Now such a lead of the increase of the results with respect to the expenditures is characteristic of many scientific organizations of the republic.

The overcoming of departmental barriers and the consideration of the regional factor are one of the promising directions of the further intensification of science. Practical experience shows that there are still many unsolved problems here.

In the past two to three decades science has acquired independent importance as a sector of the national economy with a special structure of research and service organizations, which is characteristic only of it, a system of planning, financing, accounting and reporting, stimulation. At the same time applied science is completely subordinate administratively to the management of production sectors and associations and is divided into departmental sectors. For example, the scientific institutions located on the territory of

the Belorussian SSR are subordinate to about 60 union and republic ministries and departments. The subordination of scientific organizations to departmental interests has definite advantages, ensuring the development of the direct contacts of scientists with production personnel and the acceleration of the practical implementation of the results of scientific research and experimental design work.

However, as the national economy develops, the sectorial subordination of science is coming more and more into conflict with the intersectorial nature of the problems being solved by it. Problems of an economic and social nature, the solution of which is beyond the capability of a single ministry or department, are arising more and more often. It is possible to solve them only by the joint efforts of organizations which belong to different ministries and departments. For example, in 1986-1990 many scientific institutions of the republic will participate in the fulfillment of the assignments of the Food and Energy Programs and will work on the problems of the economic and social development of the countryside and the intensive development of the natural resources of the Polesye Lowland in combination with a wise ecological policy. For work of such a scale it is necessary to learn to combine successfully the sectorial and regional approaches to scientific and technical progress.

The departmental dissociation of research institutions complicates their coordinated participation in the solution of the scientific, technical and socioeconomic problems of the territory on which they are located. This problem is very urgent for Belorussia. Unfortunately, many scientific organizations are giving inadequate assistance to the enterprises of their region. A survey conducted in 1984 showed that on republic programs, for example, 20 percent of the total amount of scientific research and experimental design work is being performed at the BelrybNIIproyekt [possibly--Belorussian Scientific Research and Planning Institute of the Fish Industry] , up to 10 percent at the Dormash and Dorstroytekhnika scientific production associations, only 2-4 percent at the Scientific Research, Design and Technological Institute of Founding of the Automotive Industry and the Minsk Affiliate of the All-Union Scientific Research Institute of the Bearing Industry. At many scientific institutions the share of the impact, which was obtained at Belorussian enterprises, in the total amount of the economic impact from the introduction of their developments in production is also very low. For example, at the Scientific Research, Design and Technological Institute of Founding of the Automotive Industry this indicator came in 1983 to about 2 percent.

The efficient coordination of the efforts of research institutions, enterprises and organizations, which belong to different ministries and departments, is necessary not only when solving major comprehensive problems, but also for the successful introduction in practice of the results of individual scientific works. For example, the Institute of Bioorganic Chemistry of the Belorussian SSR Academy of Sciences developed the principles of radioimmunological microanalysis, which makes it possible to make a quick and accurate diagnosis of a number of diseases. For the use of the new method in medical practice it was necessary to set up the production of X-ray diagnostic kits. The institute assimilated on its own the corresponding

technology and produced a pilot industrial batch of the kits. The functions of the head organization for this problem were assigned to it. However, the lack in the country of the industrial production of the compounds belonging to the kit (a total number of about 80 descriptions) forced the institute to assume on its own the development of the technology of obtaining them. These compounds decay quite rapidly, due to which the length of the cycle from the production of the kits to their use at clinics should not exceed 2 months. It is difficult for the institute to solve these problems independently and fully, ultimate success on the national economic scale depends on the efficiency of the interaction of organizations and enterprises of health care and the medical and chemical industries.

It is not surprising that at present a persistent search is being made for new interdepartmental and regional forms of the management of science. Suffice it to recall the extensive use of the goal program method of planning and the gradual development of an entire set of state, republic and regional programs, which have as a goal to unite research and design organizations and enterprises regardless of their department affiliation in the solution of comprehensive scientific, technical, economic and social problems. Thus, 130 sectorial scientific research institutes, 50 design bureaus, 24 institutes of the Belorussian SSR Academy of Sciences, 20 higher educational institutions and 200 industrial enterprises, which are subordinate to nearly 100 ministries and departments, are participating in the fulfillment of republic scientific and technical programs during the 11th Five-Year Plan.

A policy of the consolidation of programs and the selection of problems first of all of a national economic and intersectorial scale has been adopted. The formulation and implementation during the 12th Five-Year Plan of the national economic program "Intensification" will be an important step in the direction of the improvement of the planning of scientific and technical progress and the overcoming of interdepartmental barriers. It includes five subprograms, which are devoted to the automation of production, the saving of labor expenditures, materials and energy and the increase of product quality. A distinctive feature of the program will be the participation in it of large enterprises of union subordination, which are on the territory of the republic. Among the other forms of the overcoming of departmental barriers it is possible to note the organization of scientific production and educational scientific production associations, laboratories of dual subordination and temporary scientific collectives and the conclusion of long-term contracts on cooperation at the level of ministries and departments. The effectiveness of these forms will be even greater, if the economic mechanism of the interaction of science and production is adjusted. Many enforceable enactments, which regulate the processes of the formation and use of the scientific and technical potential, require revision and specification.

Thus, in case of the location of large enterprises on a specific territory the sectors of industry do not always allocate assets for the proportionate development of the scientific potential, which would contribute to the establishment of complete regional scientific production complexes. This causes a number of structural disproportions. In particular, much has been said and written about the lag in the republic of chemical science behind the development of chemical production, but things have not budged an inch.

The inadequate attention on the part of a number of union sectors to the development of their own scientific and technical potential in the regions is having the result that the scientific service of enterprises of the given sectors is being thrown onto the shoulders of republic science, primarily academic science and science of higher educational institutions. The long-term scientific support of current production by the forces of these sectors of science can decrease the amount and the scientific and technical level of the results of basic research. Moreover, the organizational legal and economic conditions of the operation of academic science and science of higher educational institutions are worse suited for direct cooperation with enterprises as compared with sectorial science.

In recent times the economic contract has become the most powerful economic lever, which links academic science and science of higher educational institutions and practice. For example, during 1961-1970 with a comparatively small amount of economic contractual operations their average annual increase at the Belorussian SSR Academy of Sciences did not exceed 800,000 rubles. During the next decade the average absolute increase came already to 2.7 million rubles a year. As a result the share of the assets from the performance of economic contractual operations in the current expenditures of the Belorussian SSR Academy of Sciences has exceeded in recent years 50 percent. This indicator is even higher at the higher educational institutions of the republic. The increase of the amounts of work, which is performed in accordance with economic contracts, strengthens the tie of science with production, speeds up the process of introducing innovations and enables scientific institutions and higher educational institutions to improve the technical equipment of research.

However, the further unlimited increase of economic contractual research can lead to negative results--the retarded development of basic research. Therefore it is necessary to reject casual jobs, which do not conform to the scientific specialization of the institutes and do not follow logically from previously conducted research. The resolute consolidation of operations and the changeover to long-term scientific production relations are also required.

At the Belorussian SSR Academy of Sciences it is possible to consider this goal to be achieved: whereas in 1960 the average annual estimated cost per economic contractual theme came to 3,000 rubles, by 1970 it has reached 25,000 rubles, while in recent years it has exceeded 40,000 rubles. The economic impact on the average per introduced economic contractual work has also increased by many times. However, the consolidation of economic contracts also bears a new problem: such cooperation becomes beyond the means of medium-sized and small enterprises of the republic. This can serve as one of the causes of the decrease of the proportion of republic enterprises among the clients of scientific institutions, which are located on the territory of the Belorussian SSR.

In our opinion, regional cooperation on the themes of research and the assets being allocated for their fulfillment is a way out of the situation. Republic ministries and departments should act as centralized clients which are capable of backing with financing important scientific operations in the interests of one sector or another of the national economy. Such cooperation will create

good prerequisites for the elimination of the duplication of themes which are being elaborated by academic science, science of higher educational institutions and sectorial science. The resources freed in this case can be channeled into the elaboration of the most urgent scientific and technical problems for the republic.

In the future it is also necessary to find forms of the use of economic contractual financing for the development of basic research. For example, in case of the conclusion of major long-term contracts a special paragraph on the allocation of a portion of the assets, which are received by the academic institute, for the conducting of basic research in conformity with its scientific specialization should be included in the text. This would contribute to the expansion of research of a new type--basic in nature and at the same time aimed at the solution of specific national economic problems. First Secretary of the Belorussian CP Central Committee N. N. Slyun'kov stressed the importance of such research when speaking at the session of the General Assembly of the Belorussian SSR Academy of Sciences.

The cooperation of ministries and departments in scientific service and first of all in the material and technical supply of research should become an important direction of the intensification of science in the republic. In the future the equipment of the experiment will determine more and more both the organization of research itself and its effectiveness as a source of new knowledge. The functioning of systems of equipment instead of independent instruments, the substantial increase of the level of the standardization and compatibility of research equipment and the automation of the conducting of experiments and the interpretation of their results are the most important traits of modern research. The scientific, technical and economic necessity of the combination of scientific instruments, research equipment and computer technology into unified combined multifunctional systems is increasing. This process creates the prerequisites for the formation of a regional and all-union network of specialized collective-use research centers.

Definite positive experience in the cooperation of scientific service has already been gained at the Belorussian SSR Academy of Sciences, where the centralized instrument and other technical supply of research by the forces of the Central Design Bureau with a pilot works is being successfully developed. Five centers of the collective use of general-purpose scientific equipment and automated systems for research are in operation, the reactor of the Institute of Nuclear Physics and the Computer Center of the Institute of Mathematics are being used collectively. The Center of Automated Spectroscopic Measurements (TsACI), which was established at the Institute of Physics in 1973, has acquired all-union fame.

The process of the territorial and interdepartmental centralization and collectivization of various forms of scientific service is objective and inevitable. It makes it possible to achieve a high level of the material, technical, information and personnel supply of research with a large saving of assets and time. In Minsk, where an overwhelming portion of the scientific and technical potential of numerous ministries and departments is located, cooperation will make it possible to save millions of rubles by the rejection of the development of the research "subsistence economy." While in cities

with a low concentration of the scientific potential such cooperation will help to acquire expensive equipment for the conducting of research at a modern level.

Interdepartmental regional centers of scientific service, which have been given extensive duties and rights and have complete information on the needs, availability and actual workload of research equipment in the given city, should be established in the immediate future. Their goal is to increase the level of supply of research by means of local resources and to achieve the intensive use of the available technical base. Moreover, cooperation is necessary not only in case of the use, but also in case of the purchase, assimilation and maintenance of scientific equipment. Perhaps, it is worthwhile, much like the Ukrainian SSR Academy of Sciences, to think about the creation of mobile sets of modern scientific equipment for the assistance of outlying scientific institutions and higher educational institutions. One must not be delayed with the implementation in daily practice of the ideas of the collectivization of scientific service, although, of course, there are considerable difficulties here. We believe that the study of these problems and practical measures should, without being shelved, be included in the general republic program of the development of scientific instrument making.

At present the formulation of the republic Comprehensive Program of Scientific and Technical Progress for the Period to 2010 has been started. Without a doubt, the gained experience will make it possible to increase the practical utility of forecasting estimates of the development of science and the scientific potential of the republic. It is important, in our opinion, to retain the cells of specialists, which took part in the preceding stage of the work. Wherever there were no such groups, it is necessary to create them, first of all in the Belorussian SSR Ministry of Agriculture.

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ORGANIZATION, PLANNING AND COORDINATION

COORDINATION OF KAZAKH MEDICAL RESEARCH

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 12, Dec 84 pp 4-5

[Article: "On the Implementation of the Joint Decree of the Session of the General Assembly of the Kazakh SSR Academy of Sciences and the Kazakh SSR Ministry of Health of 30 June 1981"]

[Text] Preliminary organizational work, which is connected with the formulation, coordination and approval of comprehensive plans of scientific research, which are liable to fulfillment by the institutions of the Kazakh SSR Academy of Sciences and the Kazakh SSR Ministry of Health, has been performed to execute the joint decree of the General Assembly of the Kazakh SSR Academy of Sciences and the Kazakh SSR Ministry of Health of 30 June 1981. By the joint decree of the Presidium of the Kazakh SSR Academy of Sciences and the Collegium of the Kazakh SSR Ministry of Health of 12 November 1981 the Commission for the Scientific Principles of Medicine was reorganized into the interdepartmental Scientific Council of the Kazakh SSR Academy of Sciences and the Kazakh SSR Ministry of Health for the Coordination of Scientific Research in the Area of Medicine, the charter and statute on the council were approved.

The scientific council drew up a coordinating plan of joint scientific research work on the most important directions of the theory and practice of health care and the implementation of the scientific results of the basic and applied research, which are being performed by the Academy of Sciences and the Kazakh SSR Ministry of Health in 1981-1985. In all 14 institutions of the Academy of Sciences, 13 institutions of the Ministry of Health and 6 institutes of the Kazakh SSR Ministry of Higher and Secondary Specialized Education are taking part in the performance of the joint operations.

Research is being successfully conducted on the theme "Develop the Scientific Principles of the Control of Influenza." The Institute of Microbiology and Virology and the Institute of Chemical Sciences are developing a technology of the production of a fundamentally new flu vaccine from the surface proteins of the virus. Materials on the technology of the production of a subunit flu vaccine have been prepared for submission to the Control Institute of Vaccines and Sera of the USSR Ministry of Health.

Comprehensive research is being systematically performed on 12 directions of the theme "The Physiological Principles of the Increase of the Degree of

Training of the Human Body" by the Institute of Physiology jointly with the Scientific Research Institute of Experimental Surgery, the clinics and chairs of the Astrakhan State Medical Institute, the Institute of Cardiology, the Institute of Nutrition and the Institute of Physical Culture.

As a result of the research, which is being conducted by the Institute of Zoology jointly with the Scientific Research Institute of Epidemiology, Microbiology and Infectious Diseases of the Kazakh SSR Ministry of Health on the theme "The Scientific Principles of the Control of the Helminthiases of People in Kazakhstan," it has been established that the complete sanitation of the Shiderty natural focus of ophisthorchosis has occurred. The necessary public health measures were proposed for prevention. The natural foci of alveococcosis and the carriers of trichonella in Western Kazakhstan were identified.

The Institute of Chemical Sciences is successfully conducting comprehensive research jointly with the institutions of the Kazakh SSR Ministry of Health on five themes in the area of the development of new medicinals of a diverse spectrum of action. In particular, the technology of the commercial production of a new psychotropic compound--cephedrine--on the basis of natural raw materials was developed jointly with the Novokuznetsk Chemical Pharmaceutical Scientific Research Institute and the Chimkent Chemical Pharmaceutical Plant. In late 1983 the first series commercial output of the substance cephedrine was accomplished at the Chimkent Chemical Pharmaceutical Plant.

The antitumor compound gliophene was synthesized, while it was suggested by the Pharmaceutical Committee to develop a medicinal form which is convenient to use.

At the same time shortcomings exist in the work of the council. Not all the managers and performers of the themes are treating the matter with full responsibility and understanding. With respect to several programs so far there is no close contact between the coperformers.

The Presidium of the Kazakh SSR Academy of Sciences resolved to take note of the information on the work of the council on the implementation of the joint decree of the session of the General Assembly of the Kazakh SSR Academy of Sciences and the Kazakh SSR Ministry of Health of 30 June 1981.

The presidium obliged the buro of the council:

--jointly with the Biological Sciences Department and the Chemical and Technological Sciences Department to formulate by the end of this year a coordinating plan of scientific research work for the 12th Five-Year Plan;

--to formulate suggestions on the practical implementation of the results of the joint research with the Kazakh SSR Ministry of Health in accordance with the results of the 11th Five-Year Plan.

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BUDGET AND FINANCE

FINANCING OF SECTORIAL SCIENCE, TECHNOLOGY

Moscow FINANSY SSSR in Russian No 2, Feb 85 pp 28-31

[Article by M. L. Bashin, senior scientific associate of the All-Union Scientific Research and Design Institute for Automated Control Systems: "The Financing of Science and Technology: Problems and Solutions"]

[Text] The organization of the financing of research and development in many ways determines the rate of scientific and technical progress. Today the task is for the system of the financing of scientific and technical progress to reflect its laws and to orient sectorial ministries and enterprises toward the efficient introduction of achievements.

In recent years important measures on the further improvement of the financial and credit mechanism in the sphere of the development and introduction of new equipment have been implemented in the leading sectors of the national economy. The formation of the unified fund for the development of science and technology (YeFRNT) was of particular importance. In the machine building sectors the deductions for the unified fund for the development of science and technology from the additional profit of enterprises have been increasing with each year. At the same time the amount of the wholesale price markups for the present takes up a comparatively small share in the sources of its formation: in 1980--2.3 percent, in 1982--3.8 percent and in 1984--4.1 percent.

The changeover to the profit as the sole source of the backing of operations on the development of new equipment with financial resources requires the establishment of closer connections between the results of the implementation of the achievements of science and technology in production and the free expenditures on the conducting of research and development in the sector. This ensures the strengthening of the direct ties of the financial mechanism, which operates in the sphere of scientific and technical progress, with the end results of the introduction of research and development and increases the influence of financial methods of management on the entire "science--technology--production" cycle.

It seems that the elaboration of carefully substantiated standards of the deductions for the unified fund for the development of science and technology and standards of their use should be the basis for the increase of the efficiency of the financial mechanism. Their fundamental connection can

constitute the common standard base of the financial support of the development of science and technology in the sector.

The creation of the unified fund for the development of science and technology does not signify the simple adding up of the previously used sources. This is the changeover to a more efficient system, which makes it possible to finance completely the entire cycle of the development of new equipment, starting with the stage of basic and applied research, the development of new equipment, including its assimilation and the offsetting of the increased expenditures of enterprises during the first years of production. Financing by means of the unified fund for the development of science and technology is of particular importance for research and development with a long period of conducting and for those directions which form the scientific reserve, which ensures the large-scale production of fundamentally new equipment.

The decree of the CPSU Central Committee and the USSR Council of Ministers "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality" specified a new procedure of the financing of operations which are performed by sectorial scientific research institutes and design bureaus. They are being converted to the payment for work which has been completely finished and accepted by the client. The stage-by-stage procedure of their payment, which did not justify itself, is being abolished.

The expenditures of scientific research institutes and design bureaus from the beginning of the operations to their completion and delivery to the client are covered by means of State Bank credit or their internal working capital. The principle "the payment of expenditures" is being replaced by the more effective principle "payment for the end results." It makes it possible to transform the financial system from a system, which passively distributes assets "post factum," into an actively controlling system, which influences the progress of research and development and the evaluation of their end results.

In case of final settlements for accepted research and development their cost should be made more precise, but should not exceed the actual expenditures by more than 3 percent of the cost which is recorded in the supply order or contract. The indicated measure pursues the goal to regulate the planning of the expenditures on research and development. The changeover to the new system of the payment for operations makes it possible to increase the influence of the financial mechanism on the acceleration of scientific and technical progress and its end results, to strengthen the cost accounting relations in the sphere of the development of new equipment and to increase the responsibility of clients for the scientific and technical level of the operations and the subsequent introduction of new equipment.

The provision of sectorial scientific research institutes and design bureaus with internal working capital and the expansion of credit relations in the sphere of the development of new equipment are an important measure. The sectorial ministry thereby retains control of the choice of the themes of research and development and ensures the pursuit of a unified scientific and technical policy on the basis of the issuing of supply orders for the

performance of the most important operations. By using the tool of control, the sector at the same time is broadening the economic initiative of scientific research institutes and design bureaus, which is aimed at the increase of the efficiency of the resources being used.

The decree of the party and government envisages the creation at sectorial scientific research institutes and design bureaus of cost accounting funds of the development of the organizations by means of: accumulations which are included in the estimated cost of research and development in the amount of 1.5 percent of the annual economic impact for the client, but not more than 6 percent of the cost of the operations; 75 percent of the planned profit, which was obtained as a result of the decrease of the actual expenditures as compared with the estimated cost; the assets received from the sale of unnecessary and retired equipment which was on their balance sheet.

The new system envisages the performance of operations on the basis of supply orders (contracts), which record the content of the operations, the time of their fulfillment, the list of performers and the amount of necessary financial resources. The breakdown of the operations into stages and the issuing of separate supply orders for them are not permitting in case of financing. The ministries should approve for scientific research institutes and design bureaus in the five-year and annual plans the new indicator "The Amount of Operations, Which Have Been Completed, Have Been Accepted and Paid for by the Client." In case of the exceeding of the planned date of delivery the issuing of credit by the State Bank department is continued, but with the collection of higher interest for the use of the loan. Credits are established in the amount: prior to the planned date of delivery of the jobs--0.5 percent, after the expiration of the planned date--4 percent. The payment of interest for the use of credit is made within the limits of the sources of financing of the scientific research institutes and design bureaus, that is, by means of the allocated working capital, while in case of the payment of higher interest--from the profit of these organizations.

The instructions on the changeover of sectorial scientific research institutes and design bureaus to the new system of financing regulate in detail its content; it is planned to complete the changeover on the set date. The ministries are obliged to implement the following measures: to substantiate the sectorial plans of the amount of operations, which have been completed and accepted by the client; to approve the schedule of the changeover of scientific research institutes and design bureaus to the new system of financing.

The analysis showed that at sectorial scientific research institutes and design bureaus the amount of unfinished work comes to significant amounts, for example, in the Ministry of Instrument Making, Automation Equipment and Control Systems in 1983--53 percent of the working capital. The steady tendency for them to increase was established. If the cost of operations in the Ministry of Instrument Making, Automation Equipment and Control Systems in 1970 is taken to be 1, by 1983 it had increased by 3.5-fold.

At many scientific research institutes and design bureaus within the unfinished work it is possible to encounter expenditures on halted themes,

which have been frozen for years. There are also large above-standard stocks of materials, raw materials, components and other types of working capital, which are on the balance sheet of the organizations. Since the average period of the conducting of research and development is 5-6 years, financial resources have been removed from active circulation for a long time.

The turnover rate can serve as a clear indicator of the efficiency use of the resources which are being channeled into the development and introduction of new equipment. The comparison of the spent assets with the amounts of completed work during 1973-1983 for a large group of scientific research institutes and design bureaus shows a significant gap. The leading increase of the balances of unfinished work and the increase, which is connected with it, of the immobilization of the resources being channeled into the sphere of science and technology are continuing. Thus, in the Ministry of Machine Building for Light and Food Industry and Household Appliances the unfinished work at the end of 1983 came to 121.9 million rubles and exceeded by 44.8 percent the amount of scientific research and experimental design work which was performed by its own forces; in the Ministry of Machine Building for Animal Husbandry and Fodder Production and the Ministry of Instrument Making, Automation Equipment and Control Systems--respectively 29 and 31 percent.

The consolidated calculations attest that just as a result of the speeding up of the turnover rate of working capital and the subsequent freeing of 10 percent of its amount at sectorial scientific research institutes and design bureaus it is possible to additionally carry out 16 percent of the annual amount of work which is now performed by these organizations.

Starting in early 1983 the first group of scientific research institutes and design bureaus of a number of ministries was changed over to the new system of financing. An assignment, which determines the amount of operations, which have been completed, have been accepted by the client and are broken down by calendar periods, was included in the indicators being planned. It should become the basic one in case of the evaluation of the efficiency of the activity of the collectives, which are developing new equipment, in case of the crediting of bonuses for the fulfillment of the plans and in case of nomination for top level positions when summarizing the results of the All-Union Socialist Competition.

Since 1 January 1983 several more all-union industrial associations of the Ministry of the Electrical Equipment Industry have been changed over to the new system of settlements. This makes it possible to compare the results of the two systems of the payment for research and development--the new one and the one previously in effect. In a comparatively short time at these scientific research institutes and design bureaus their financial situation was optimized, while the time of the performance and completion of operations was reduced on the average by 30 percent.

In spite of the fact that the payment of higher interest is envisaged for the use of a State Bank loan, for scientific research institutes and design bureaus real conditions appeared for the adjustment of the amounts and the economic efficiency of assignments in the direction of their increase. This is making it possible to identify additional reserves.

The experience of the changeover to the new system of financing on the basis of the provision of the scientific research institutes and design bureaus of the Ministry of the Electrical Equipment Industry with internal working capital made it possible to speed up the delivery of projects and to decrease significantly the amount of unfinished research and development. For example, in 3 years of work under the new conditions the organizations of the Soyuzelektrotyazhmash All-Union Industrial Association decreased the amount of unfinished work, which is performed at the expense of the unified fund for the development of science and technology, by 5.9 million rubles, or 17 percent of the amount of performed and delivered work. The analysis of the activity of the scientific research institutes and design bureaus of three industrial associations showed that the delivery of work takes place on the average 48 percent more rapidly than for the sector as a whole. The fact that now the conditions have been created for the rejection of adjustments of the financial plan, which previously were frequently encountered, is also a positive fact. As a whole the financial status of scientific research institutes and design bureaus has become more stable and entirely dependent on the results of their activity.

In the financial literature it has been noted that in the sphere of the conducting of research and development the contracts for their performance are a legal lever of cost accounting. Apparently, it is more correct to assume that this is characteristic of them to an even greater degree during the subsequent introduction of the obtained results. The contract should become the basic form of cost accounting relations, within which sectorial scientific research institutes and design bureaus will introduce their achievements.

During the conducting of the experiment on the new system of payment for research and development in the Ministry of the Electrical Equipment Industry and other sectors a number of negative trends were identified, particularly the overstatement first of all of those being carried out in accordance with contracts with organizations of other sectors. The reason for this is the following: the operations at the expense of the assets of the unified fund for the development of science and technology of one's own sector are monitored more strictly by the ministry. In turn the clients from other sectors are forced to agree with the calculations of the performers.

The finance administrations of the sectorial ministries jointly with the main organizations of the sector have to substantiate all the sections of the financial plans of the scientific research institutes and design bureaus, first of all the consolidated balances of revenues and expenditures and the credit plan, and to link them with the corresponding items of the budget.

The extension of credit by the State Bank makes it possible to make financing more flexible and to create an additional source of resources for the performance of operations in accordance with contracts with clients from other sectors. Constant monitoring by the State Bank of the supply of financing and the timeliness of the repayment of obtained loans will promote the tightening up of the financial planning discipline of sectorial scientific research institutes and design bureaus.

The higher interest for the use of a loan in case of the failure to observe the planned time of the performance of operations (in the amount of 4 percent) should be paid from the profit of the performing organizations; in case of its insufficiency--from the development fund of the given organization. In our opinion, for the purpose of increasing the influence of the credit mechanism on the time of the performance of operations it is advisable that a portion of the interest from the amount on overdue loans would be paid at the expense of the material stimulation fund of the performing organizations.

In some sectors a significant amount of the operations performed by scientific research institutes and design bureaus is financed from the budget. The prevailing statutes on the accounting and calculation of expenditures, which were approved by the USSR Ministry of Finance in 1971, allow the possibility of the accounting of the expenditures on these operations with respect to all the themes as a whole. As a result the "boiler method of accounting" is being used quite extensively in practice, which enables the financial and accounting services of scientific research institutes and design bureaus to artificially "transfer" expenditures from cost accounting themes to budget-carried themes and vice versa.

It is expedient that the sectorial scientific research institutes and design bureaus would carefully take into account and cost all operations according to the sources of their financing. Only then will the real conditions be created for the gradual strengthening of the principle of cost accounting in the sphere of the development of new equipment. Closer ties of the amount of financial resources, which are allocated for these purposes, with the scientific and technical level of the completed operations and the quality characteristics of the new equipment being produced in the sector should be established. In 1983 only a portion of the new products of machine building met in their characteristics the requirement of the highest quality category, including with respect to the Ministry of Tractor and Agricultural Machine Building and the Ministry of Machine Building for Animal Husbandry and Fodder Production.

The USSR State Committee for Prices has been granted the right to establish incentive markups in the amount of up to 30 percent on the wholesale prices for new highly efficient products and reductions in the amount of up to 30 percent on the wholesale prices of products which are liable to removal from production. It is advisable to use these measures more extensively.

For the additional financing of operations, which are performed in conformity with all-union programs, a reserve of assets is being created at the disposal of the State Committee for Science and Technology by means of annual deductions from the unified fund for the development of science and technology of the sectorial ministries. In the future the centralization of resources for the implementation of the most important scientific and technical programs should be intensified and a clearer and priority nature should be lent to such financing.

In the prevailing procedural statutes on financing and planning the cost indicators of sectorial scientific research institutes and design bureaus are revealed insufficiently clearly. The sectorial ministries settle these

questions independently. As a result difficulties arise when summarizing the consolidated data which characterize the activity of the organizations which are developing new equipment. The unification of all cost and a number of other financial indicators and the specification of the methodology of their formation with their subsequent consolidation in sectorwide standardized documents are required.

At the majority of scientific research institutes and design bureaus there are no substantiated times of the performance of operations, which have been coordinated with the financial services of the sectorial ministries. In practice they are based on the expert appraisals of the performing organizations and are artificially extended. The planning and finance administrations of the sectors jointly with the main scientific research institutes and design bureaus have to substantiate these times.

The system of financial settlements for completed operations should also be improved. As the first step it is possible to recommend the changeover to payment by means of acceptance of the demands for payment of the organizations which are the performers of the operations, which will speed up substantially reciprocal financial settlements and will increase their discipline.

The experience of the changeover of a number of sectorial scientific research institutes and design bureaus to the new system of financing showed that the solution of a number of methodological problems is also required. For example, it is necessary to elaborate and legalize a precise definition of the complex concept "the introduction of the results of research and development," since it is closely connected with the mechanism of their financing. In this connection it is impossible to agree with the simplified interpretation of this concept, which is encountered in the literature.[1] Given such an approach the decisive component of the impact of the resources being channeled into the sphere of research and development--the scale of the introduction of the innovation--is ignored. It is well known that the orientation toward the "introduction" of the notorious display model gave rise to large financial losses in the sphere of scientific and technical progress.

In the work on the further improvement of the financial mechanism it is important to ensure the closer cooperation of the financial services of the sectorial ministries with the State Bank departments which will give substantial assistance to scientific research institutes and design bureaus when formulating the indicators of the financial plan.

FOOTNOTE

1. See "Osnovy upravleniya naukoy" [The Principles of the Management of Science], Moscow, 1983, p 25.

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BUDGET AND FINANCE

FINANCING OF SECTORIAL TECHNOLOGICAL INSTITUTES

Moscow FINANSY SSSR in Russian No 10, Oct 84 pp 33-37

[Article by Yu. I. Berliner, chief of a department of the All-Union Means of Mechanization and Production of Instruments Industrial Association (Soyuztyazhmashtekhnologiya): "Proportions in the Sources of Financing of Sectorial Technological Institutes"]

[Text] The most important lever, which makes it possible to increase the efficiency of the activity of sectorial scientific research institutes and planning and technological institutes, is the optimization of the proportions in the sources of financing of the operations performed by them. The degree of concentration of the forces of the institute on the basic directions of technical progress in the sector, the importance of the operations being performed and others, that is, in the end its role in the increase of the level of technology at the enterprises attached to it in many ways depend on this.

At present scientific and technical development of sectorial institutes is financed by means of: allocations from the state budget, bank credits, the unified fund for the development of science and technology (YeFRNT) and noncentralized assets, which, as a rule, have been attracted in accordance with economic contracts. These sources are being used unequally; for example, bank credit is practically not being used at all. The work on state scientific and technical programs for the group of institutes in question is usually financed from the unified fund for the development of science and technology.

As the analysis of the sources of financing of the technological institutes of the Ministry of Heavy and Transport Machine Building shows, for the most part they are broken down as follows: 40 percent of the total amount of financing is through the unified fund for the development of science and technology, 55 percent is through economic contracts with enterprises of their own ministry and up to 5 percent is through economic contracts with enterprises of other ministries and departments. Here at the enterprises the same centralized assets (the unified fund for the development of science and technology) are the source of assets for concluding economic contracts with the institutes; the results of the activity of the enterprise, for example, the product cost, very rarely serve in such cases as a source of financing.

Unfortunately, thus far there are no sound recommendations on the optimization of the ratio of the sources of financing of various types of scientific and technical organizations and kinds of operations. The available recommendations on the amount and sources of the deductions for the unified fund for the development of science and technology of the ministry are also not well-defined.[1] In the Ministry of the Electrical Equipment Industry, for example, the standards of the deductions for the unified fund for the development of science and technology are established as a percent of the planned volume of sales of the commodity production, in the Ministry of Heavy and Transport Machine Building--as a percent of the volume of the standard net output. In the Ministry of the Electrical Equipment Industry 30 percent of the amount of the planned profit is deducted in accordance with the standard, in the Ministry of Heavy and Transport Machine Building 6.2 percent of the standard net output is deducted. The necessary procedural instructions on the principles of the distribution of assets among enterprises are also lacking. In practice the amount, which is allocated to the enterprise from the unified fund for the development of science and technology, depends not so much on the plan of the output of new equipment as on the amount of assets available in the sector. This, of course, complicates the determination of the sources of financing of scientific research, planning, design and technological work.

Today a single recommendation of the USSR State Committee for Science and Technology exists: 20 percent of the assets, which are allocated to the institutes from the unified fund for the development of science and technology, are to be channeled into the creation of a scientific and technical reserve. The proportions in the sources of financing of the remaining amount of work are not regulated. This is explained not only by the complexity of the problem, but first of all by the lack of statistical material for the elaboration of sound recommendations. As a result in practice even for enterprises of the same type, with an approximately identical direction and nature of work, such proportions differ sharply. Moreover, many of them are poorly promoting the achievement of the ultimate goal, the introduction in production of highly efficient scientific and technical developments.

At a number of institutes, for example, the following proportions of financing have formed: up to 75 percent through assets of the unified fund for the development of science and technology, up to 15 percent through economic contracts with enterprises of other ministries and departments. This did not orient the institutes toward the choice of the most efficient themes and toward the real end results of the work. In spite of the established statute, which orders the assets of the unified fund for the development of science and technology to be channeled into operations on the creation of a scientific and technical reserve and the technical development of the sector, they served developments connected with purely plant measures. Not only were technical specifications formulated with these assets, but machines and devices were also executed in metal and their introduction in production was carried out. The expenditures for the improvement of production, which the plant should bear, were paid for by the institute. This could not affect the attitude of both parties toward the work being formed. The developments financed by the institute did not completely satisfy the plant, while it, in signing the documents connected with the technical and economic indicators of the work,

did not itself make serious demands, since all this was not reflected in its reporting, including statistical reporting.

The increase in the total amount of operations of the sectorial institute of the proportion of those, which are financed from the unified fund for the development of science and technology, increases the number of research, analytical, information and statistical themes due to the technical innovations, which are connected with development and introduction at the enterprises of the sector. And, on the contrary, the increase of the amount of operations, which are financed in accordance with economic contracts, decreases the amounts of operations, which are aimed at the creation of a scientific and technical reserve and promising solutions, as a result of which the institute ceases to be the vanguard unit of scientific and technical progress in the sector. The technical administrations of the ministry through the corresponding all-union industrial associations formulate the themes of the institute, but depending on the overall orientation of its activity (scientific research, planning and technological and so on) the proportions in the sources of financing of operations can be different.

In recent years organizational and technical measures on the optimization of these proportions have been implemented in the Ministry of Heavy and Transport Machine Building. As a result of many years of analysis of the structure of the research performed by sectorial institutes, the classification of their clients, the formed and promising directions in work and other factors two basic types of proportions in the sources of financing were recommended: in the total amount of financing of the operations of the institute and the breakdown of the unified fund for the development of science and technology.

Judging from experience, it is possible to regard as the best breakdown of assets in the total amount: 55 percent--operations which are financed in accordance with economic contracts with enterprises and organizations of one's own ministry, 35 percent--through the unified fund for the development of science and technology and 10 percent--in accordance with economic contracts with enterprises of other ministries and departments. Of course, these are average figures and depending on the specific orientation of the operations of the institute they can change somewhat. For example, at the institute, which is the main one for a number of technological process stages or is working on the long-range development of the sector, up to 45 percent of all the operations can be financed from the unified fund for the development of science and technology. The same thing goes for the technological scientific research institute, at which operations on the creation of a scientific and technical reserve predominate.

The assets allocated to the institute from the unified fund for the development of science and technology are intended first of all for the solution of problems connected with the prospects of the development of the sector. These are research (experiments) on the development of new technological processes and equipment, technical and economic research, research on scientific and technical information, patent and license work and standardization. These are the formulation of technical, economic, social and other forecasts of the development of the sector (subsector); organizational and procedural operations in the area of new equipment and the scientific

organization of labor (planning, coordination, the analysis of the results, quality control, the writing of instructions, methods) and others.

When determining the amounts of assets which are being allocated to the institute from the unified fund for the development of science and technology, it is necessary to take into account the following circumstance. In the past decade owing to large qualitative changes in the nature of production (the development and introduction of computer-aided systems of the designing of products and the control of production, its robotization, the organization of versatile automated production systems, new methods of planning the production of output, the development and introduction of new equipment and others) the process of its control has become complicated. This also affected several functions of the technological institutes. In particular, the functions, which are connected with the preparation of scientific and technical information in accordance with the long-range plans of the development of the sector (subsector) with the drawing up of standard materials, are being broadened significantly. The main thing is that now the institute, which was previously called upon to give recommendations on some problems or others, is becoming a direct participant in the process of the elaboration and implementation of decisions on the development and improvement of production.

The assets being allocated to the institute from the unified fund for the development of science and technology are allotted for operations which are connected: up to 20 percent--with the prospects of the development of the sector (subsector), standardization, metrology, scientific and technical information and others; about 15 percent--with the development of new directions in production technology (the development of robotized sections, automated technological complexes, control systems and others); 3 percent--with the formulation of standard technological decisions, cooperation with CEMA; 2-3 percent--with the fulfillment of assignments of the government, the solution of basic scientific and technical problems, problems of the natural sciences and social sciences.

The cited proportions in the sources of financing, which were obtained on the basis of statistical data, make it possible to shift to a standardized method of the planning of the amounts of operations and the expenditures on them. The proportions should be coordinated with the tasks of the sectorial institutes. Here the coincidence of the time of financial and thematic planning is, of course, of great importance. Therefore in accordance with the procedure, which has been adopted in the Ministry of Heavy and Transport Machine Building, in May of the year preceding the year being planned the first version of the thematic plan of the institute is drawn up, while in November it is approved. This also coincides with the time of the issuing of financing plans to the institutes. Moreover, a reserve--up to 10 percent of the total amount of work--is left in the thematic plans for the fulfillment of assignments which appear during the year and for the specification of the sources of financing.

However, the establishment of the optimum proportions in the sources of financing is only one aspect of the matter. It is no less important to use the allocated assets efficiently.

The largest amount of financing of operations is in accordance with economic contracts of the institutes with enterprises. For the most part these are operations on the initiative of the client or the performer and to a smaller extent of a directive nature. As was already said, first of all the assets of the unified fund for the development of science and technology, which are allocated by the ministry, are the source of financing of such contracts for the plant. This predetermines the corresponding approach of enterprises to the conclusion of contracts, the payment for which does not affect in any way their economic operations. As a result operations, which are aimed not at the development of equipment and technology at the enterprise, but, in essence, at assistance to the plant in the drawing up of technical specifications, which is its direct duty, are frequently performed by means of economic contracts. It is necessary to increase the responsibility of the institute for the choice of themes of scientific research.

On the other hand, the plant frequently does not have assets for the conclusion with institutes of contracts for the implementation of measures on new equipment. The economic experiment on the broadening of the rights of production associations (enterprises) and the increase of their responsibility for the results of work, which has been conducted since 1984 by the Ministry of Heavy and Transport Machine Building, envisages the leaving at their disposal of a specific proportion of the assets of the unified fund for the development of science and technology for enterprising operations on the introduction of new equipment, which, of course, broadens the opportunities of enterprises. At the same time one should regard as one of the means of increasing the efficiency of developments the conclusion of contracts which are paid for by means of the product cost. Some inconveniences of the enterprise in this case are offset by the positive end result--the development and introduction here of efficient new equipment. Moreover, the rejection of this source of financing to some degree decreases the economic interest of enterprises in its quickest development and introduction.

A few words about the financing of operations on the creation of a scientific and technical reserve. As the analysis of the thematic plans, which are envisaged by directive, convinces us, 20 percent of the amount of the unified fund for the development of science and technology (10-12 percent of the total amount of work of the institute) is quite sufficient for the performance of such operations. However, the analysis of their themes shows that in quality it does not always conform to the posed tasks.

The reason for some difficulties of the organization of the financing of operations on the creation of a scientific and technical reserve consists in the vague formulation of this concept. It is not established in the known directive documents. The formulations, which exist in various sectorial instructions, including financial and accounting instructions, are interpreted in different ways. For greater certainty it should, in our opinion, be assumed that the scientific discovery is the result of basis research, the invention--of applied research, the introduction in production of the results of research work--of development.

The differences in the types of institutes (academic, sectorial, scientific research, planning and technological and so on) dictates the nature and

organization of the operations on the creation of a scientific and technical reserve. As applied to sectorial scientific research institutes and planning and technological institutes the results of the operations, which have been performed at academic institutes and higher educational institutions, as well as the results of their own basic and research operations can form the reserve. In any case, regardless of the scale of the practical application of previous research, at the sectorial institute the operations on the creation of a scientific and technical reserve should solve the problems of the development of equipment and technology precisely in this sector. The solution should be a new one which was previously unknown in the sector. This confirms the idea expressed above that the invention should be the result of applied research, the use of known solutions is the destiny of development. The role of the latter especially increases in case of the use of solutions, which are known in other sectors, or foreign know-how.

Technical, economic and patent information research, scientific forecasting, analytical operations on the evaluation of the technical level of works and the individual objects of equipment, which are used in the sector, and the determination of the scientific and technical problems, which are liable to solution, should precede or accompany the operations on the creation of a scientific and technical reserve.

When planning operations on the creation of a scientific and technical reserve both the needs of the retooling of operating production and the prospects of the construction, renovation and expansion of enterprises, the assimilation in the future of the output of new items, the increase of the production volumes and the increase of product quality are taken into account. It is possible to enlist in them the scientific forces of academic institutes and higher educational institutions. The operations on the creation of a scientific and technical reserve conclude with the drawing up of scientific and technical documents. In accordance with their nature and purpose they usually do not contain stages which are connected with the introduction of the equipment being developed. However, there can be the stages of the development and experimental testing of prototypes. The positive results of operations on the creation of a scientific and technical reserve, as a rule, call for their introduction in production.

The specification of the concept "scientific and technical reserve" makes it possible to differentiate more strictly the themes of the institute and the sources of financing. The possibility of the financing from the unified fund for the development of science and technology of ordinary operations, which, without opening new roads in the development of technology, are the prerogative of the plant, disappears.

The correctness of the proportions in the sources of financing and the increase of the efficiency of the use of allocated assets depend primarily on the established procedure of the inclusion of operations in the thematic plan and on the selection and approval of the themes. First of all this concerns operations which are financed from the unified fund for the development of science and technology. In conformity with the decree of the CPSU Central Committee and the USSR Council of Ministers of 24 September 1968, "On Measures on the Increase of the Efficiency of the Work of Scientific Organizations and

the Acceleration of the Use in the National Economy of the Achievements of Science and Technology," institutes are given the right to propose the themes of enterprising operations on the implementation of individual scientific and technical proposals, as well as the themes of basic research in fundamentally new scientific and technical directions. The rights are given on the condition of the observance of the centralized principle in planning. This was also confirmed once again in the Accountability Report of the CPSU Central Committee to the 26th CPSU Congress: "To formulate clearly the practical tasks, which require the maximum attention of scientists, is the affair first of all of central planning and economic organs, the State Committee for Science and Technology. At the same time science itself should also be a constant 'disturber of the peace,' showing in what sections stagnation and a lag have been noticed, where the present level of knowledge makes it possible to move ahead more rapidly, more successfully." Thus, the interrelations between the institute and the superior organization can be formulated in the following manner: "information on what 'it is possible to do for the development of science and technology' should come 'from below,' information on what 'it is necessary to do' and who needs to do it, in what sequence problems should be solved, on the basis of national economic goals and priorities, should come 'from above.'"[2] Finding its way into the thematic plan of the institute, which the superior organization supports, the theme becomes the practical business of not only its initiators.

A procedure of the inclusion of operations in the thematic plan has been established in the Ministry of Heavy and Transport Machine Building. All the themes, which are financed from the unified fund for the development of science and technology, are included on the basis of the initial demands, which are elaborated by the institutes and are approved by the all-union industrial associations or the administrations of the ministry. The latter reflect the essence of the work being outlined, the technical and economic results in case of its fulfillment, the novelty of the question, the sources of financing, the amounts and formation of material stimulation. The initial demands are submitted for the approval of the main and other interested organizations.

An analogous procedure of inclusion in the thematic plans has also been adopted for operations in accordance with economic contracts. In this case a technical and economic substantiation is drawn up for each one: why the given theme is being planned, what the state of the problem and the special purpose of the work, its proposed novelty and technical level, the necessary expenditures on the elaboration of the theme and the introduction of its results, the proposed economic efficiency and the basic factors, which form it, are.

The introduction of documents, which substantiate the inclusion of a job in the thematic plan, encounters a number of difficulties, particularly of a psychological nature. Many workers of institutes underestimate the role of the serious preliminary selection of themes. They do not consider it necessary to substantiate with documents the advisability of new research and development precisely in the proposed direction and consider it possible to rely only on the knowledge and experience of specialists, engineering intuition and so forth. At the same time when examining in the ministry the

documents for the opening of themes only 20 percent of them are accepted without remarks. Up to 30 percent of the submitted jobs for various reasons are rejected altogether, the remainder undergo adjustment.

The introduction for sectorial technological institutes of the above-stated procedure of the inclusion of jobs in the thematic plans made it possible to regulate the proportions in the sources of financing and to increase the effectiveness of the measures on new equipment, which are being outlined and implemented. At the same time another fundamental problem was solved: the financing of the organization as a whole should be replaced by the financing of themes which are aimed at the solution of the most important problems of the sector.

The intensification of the specialization of institutes, the elimination of the duplication of operations by different institutes and, as a result, the reduction of expenditures are an important factor of the more efficient use of the assets which are being allocated for scientific research, planning, technological and design work. The necessary efforts have been taken by the ministry. For individual directions (the mechanization of painting operations, the technology of electroplatings, the production of parts made from nonmetallic materials and others) the operations were concentrated at only one institute, at others these themes were closed. The main organizations for technological process stages, which coordinate the operations of the institutes, were selected. For example, the Kirov Planning, Design and Technological Institute of Heavy Machine Building became the main organization for the mechanization of painting operations. Structural reorganization was carried out there, the number of subdivisions, which are specialized in such operations, was increased by more than fourfold, which, of course, could not but increase--and significantly--their technical level and quality. The cost of developments was reduced by approximately 30 percent. This is a direct consequence of the extensive use of standard decisions in case of the implementation of developments for many enterprises of the sector and the shortening of the time of designing owing to the greater skills of the personnel and the possibility of using workers of average skill in the standard decisions.

The saving of assets, as the result of the intensification of the specialization of institutes, is especially felt in case of the development of promising technological processes, designs of special and nonstandard equipment and documents for the construction, renovation and retooling of enterprises. For example, when developing promising technological processes and the working documents for the Krastyazhmash Production Association more than half of the amount of work was performed by sectorial technological institutes and by subdivisions, which had been approved as the main ones for some technological process stages and directions or others. This made it possible to reduce on the average by 15 percent the time and by 20 percent the cost of designing as compared with the performance of such operations by nonspecialized organizations.

The establishment of the optimum proportions in the sources of financing of scientific research, planning, design and technological work enables the planning and financial organs of ministries to distribute more efficiently the

financial resources for the development of science and technology among enterprises and organizations and within them, to choose the most efficiency means of the quickest turnover of invested assets, to concentrate the activity of institutes on the most effective directions and in the end to accelerate scientific and technical progress in the sector.

FOOTNOTES

1. Ya. Lyubinetskiy, V. Shalimov, "The Standards of the Formation of the Unified Fund for the Development of Science and Technology," PLANOVOYE KHOZYAYSTVO, No 11, 1979, pp 50-59; L. F. Pavlyukova, G. A. Tsaritsina, "The Increase of the Role of the Unified Fund for the Development of Science and Technology in the Economic Stimulation of the Development of New Equipment," VESTNIK MASHINOSTROYENIYA, No 8, 1982, pp 96.72.

2. "Upravleniye razvitiyem nauki i tekhniki" [The Management of the Development of Science and Technology], Moscow, Ekonomika, 1980, p 73.

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BUDGET AND FINANCE

EFFECTIVENESS OF EXPENDITURES ON SCIENCE

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[Article by Candidate of Economic Sciences S. V. Onyshko, scientific associate of the Institute of Economics of the Ukrainian SSR Academy of Sciences: "The Effectiveness of Financial Expenditures on Scientific Activity"]

[Text] The increase of the effectiveness of expenditures on scientific activity is an urgent and multidimensional problem. This is connected not only with the vast resources, which the state allocates annually for scientific research and experimental design work, but also with the role which science plays in social development. The analysis of the problem of increasing the effectiveness of expenditures on scientific activity reveals two basic aspects of its solution. On the one hand, the achievement of the maximum yield of the assets, which are being allocated for the development of science by means of the more complete utilization of the obtained results of research, and, on the other, the economical and efficient expenditure of these assets. Such an approach ensures the mobilization of unused reserves and is directly connected with the processes of the further efficiency and intensification of science.

The multidimensionality of the problem of increasing the effectiveness of the expenditures on scientific activity makes special demands on the methodology of its study. In particular, it is necessary to specify two methodological aspects which did not find sufficiently complete reflection when solving this problem. It is a question of the inadequate connection of all the work on the seeking of reserves of the improvement of the use of the assets for scientific activity with the processes of the increase of the efficiency and the intensification of sciences. These processes reflect most completely the essence of the present stage of the science. The increase of its efficiency is revealed as a component of the saving on the costs of social production, while the increase of its intensification is revealed as the decrease of the outlays on the development of science directly.

While regarding the increase of the efficiency of science as an aim of society, it is possible to define the process of its intensification as one of the important means of achieving this goal. In economic literature the process of intensification is studied, as a rule, only in connection with the study of the problems of efficiency. In case of such an approach the

questions, which are connected with the saving on the costs of the development of science, are not examined. As a results the processes of the increase of both the efficiency and the intensification of scientific activity prove to be inadequately studied. In this connection the lack of a direct connection of all the work on the mobilization of reserves of the improvement of the use of the assets for scientific activity with the processes of the efficiency and intensification of science seems economically unsound.

The nature of these processes does not make it possible to differentiate clearly between the factors of the increase of the effectiveness of the expenditures with allowance made for their influence on one type of costs or another. Therefore it is necessary to group all the factors of the increase of the effectiveness of the expenditures, including the financial factors, according to the attribute of the reflection by them of the processes of the efficiency and intensification of science. Such a grouping in case of the analysis of the activity of scientific institutions will make it possible to take more completely into account their entire set for the purpose of identifying the unused reserves.

The concept of the economical expenditure of the allocated assets as applied to the sphere of scientific activity has its own peculiarities. The incomplete assimilation of the allocated resources, their unsound use or use not for the immediate purpose can do harm to the development of science, and not only at the given stage, but also in the future. This has been demonstrated by practice. The economical expenditure of assets for scientific activity implies only their prudent and purposeful use in the interests of society. Such an approach does not signify the narrowing of the sphere of the search for means of improving the use of financial assets for scientific activity.

The problems of increasing the effectiveness of expenditures by means of the identification of the unused reserves are among the problems which along with the requirement of a comprehensive approach to their solution are especially in need of detailed specification and the discernment of all the peculiarities of the object of research. The consideration of the specific nature of the object being studied should become another important methodological aspect when solving the problem of increasing the effectiveness of the financial expenditures on scientific activity.

The organizational economic mechanism of management as applied to the spheres of production and scientific activity has essential differences. The need for their consideration when improving this mechanism is obvious. The unacceptability of individual methods of the planning of expenditures, particularly the cost accounting of expenditures--a method which ensures a high level of planning work in industry--has a great influence on the mechanism of the planning of expenditures on science. The methods and means of the financial support of scientific research are very unique.

In practice scientific institutions and organizations have certain opportunities for the consideration of the specific nature of their activity. The limited group of approved plan indicators broadens significantly the possibilities of scientific institutions in the shifting of financing

resources (within the earmarked appropriations) with allowance made for the specific nature of each of them. The right granted to scientific institutions to make changes in the estimate of the expenditures, and particularly for the acquisition of equipment, also reflects the specific nature of their activity. With respect to other budget-carried institutions these expenditures, as a rule, are limited. Many differences also found their reflection in the process of the improvement of the organizational system of the financing of science, which has been carried out in recent years, and thereby significant prerequisites were created for the increase of the effectiveness of financial expenditures on scientific activity. At the same time experience attests that such differences have not yet become the basis, on which the organizational economic mechanism of the management of scientific activity is improved. This not only decreases the effectiveness of the use of the assets, which have been allocated for science, but in individual cases also hinders its further development.

In evaluating the existing statutes in the area of the granting to scientific institutions and organizations of rights for the day-to-day settlement of questions of the planning and financing of operations, it must be noted that they do not always have adequate scientific grounds and practical application. The elaboration of a comprehensive mechanism of the management of scientific activity, which has been set down in procedural materials and enforceable enactments, is necessary. Among the other measures in it, in our opinion, there should be envisaged, on the one hand, the rights of scientific institutions and organizations in the day-to-day solution of a number of problems, which stem from the specific nature of their activity, and, on the other, economic penalties for the inadequate use (in accordance with necessity) of the granted rights, which entailed the decrease of the effectiveness of the assets allocated for scientific research.

While stressing the importance of the consideration of the differences which exist in the area of financial policy as applied to the spheres of production and science, the need for the more precise consideration of the specific nature of not only science in general, but also each field of it should be indicated. This is dictated by the special functions of each science with respect to the other sciences which belong to the given classification group. In spite of the similarity of the main principles, there are inherent in the specific fields and even individual studies and developments their own specific peculiarities, which to a significantly smaller extent find their reflection in the mechanism of the management of science. At the same time they have a significant influence on the process of using the assets being allocated, which makes it possible to regard them as unused reserves in the increase of the effectiveness of the expenditures on scientific activity. Consequently, the refinement of the methodology of studying the problem makes specific adjustments in the study of the individual factors which govern the effectiveness of the expenditures on scientific activity.

The denial of the possibility of using with respect to academic institutions the method of financing by means of the conclusion of economic contracts seems economically unsound. While recognizing the role of budgetary sources, the poor coordination of this type of financing (which automatically ensures the current reimbursement of expenses) with the solution of the problem of

increasing the efficiency of research should be stressed. Under the conditions of the use exclusively of this source the stimulating role of finance in the choice of the most effective research, in its timely completion and the increase of the practical return decreases.

Great reserves of the increase of the effectiveness of expenditures at academic scientific institutions are incorporated in the use of the contractual form of financing. In the past 15 years the amount of work, which has been performed by academic institutions in accordance with economic contracts, has increased by nearly fourfold. The use of this form of financing was conducive to bringing science closer to the demands of the sectors of the national economy and, consequently, became an important factor of the increase of its efficiency. Moreover, this source made it possible to offset the additional need, which arises in a number of cases, for budget allocations for the performance of work.

At the same time the sphere of the use of the contractual form of financing should be broadened with allowance made for the specific nature of the individual fields of science. Contractual research is not characteristic of the system of the social sciences. At the same time, owing to the specific nature of economic science, the institutions of this type can perform a significant amount of work of a contractual nature for various institutions and organizations. The use of such a form of financing should be regarded as an important reserve of the increase of the efficiency of each field of scientific activity. Meanwhile the fluctuations in the level of cost accounting financing (per associate) by sections of the Ukrainian SSR Academy of Sciences are very significant. This for the most part is a result of the need for the consideration of the totality of factors when choosing the sources of financing.

Under present conditions, when difficult tasks on the improvement of the planning and management of the national economy have been posed for economic science, it is necessary to specify the time of the conducting of economic research which is connected with the solution of global problems. It is advisable to coordinate its duration with 5-year national economic planning. In this case its results can directly influence the economic policy of the coming 5-year period. Consequently, given such an approach the prerequisites are created for the real increase of the efficiency of this research. For the purpose of expediting the readiness of operations and the sound distribution of efforts, there should be introduced the two-stage fulfillment of themes, in case of which the scientific report, which includes the basic conclusions and ideas of the study, is prepared at the first stage, while at the second the end results are prepared in the form of developed methods and basic monographs.

The careful analysis of the peculiarities inherent in the individual fields of scientific knowledge makes it possible also to solve more soundly other problems which are connected with the further increase of the efficiency and intensification of scientific activity. In our opinion, their influence on the choice of the methods of determining the resources, which are allocated for the development of science, is also substantial, which owing to the limitedness of the latter is assuming considerable importance. Three methods

of planning the amounts of expenditures of a scientific institution are known to practice. The most frequently used one is the base method. It envisages the determination of the amounts of expenditures on the basis of individual types of outlays. Taking into account the uncertainty which is inherent in scientific research, it is very difficult to achieve the proper effectiveness of this method. The use when estimating future outlays of the indicators, which were achieved during the preceding period, including with respect to such a significant type of expenditures as the wage fund, decreases significantly the interest in the efficient expenditure of assets.

The economically more sound determination of expenditures as a whole for the organization by the overcoming of the duplication of themes is achieved on the basis of the use of the object-goal method. Here the amount of expenditures of the scientific institution is the aggregate of the estimated costs of all the themes being elaborated. However, such a method applies only to sectorial scientific research institutes. For academic institutes, which perform basic research, the determination of the total limit of expenditures is used. This is due to the difficulties in the substantiation of the amounts of financial resources by individual themes. In case of the object-goal method of the planning of expenditures at academic institutions the need arises for the creation (simultaneously) of compensatory reserves for the reimbursement (if necessary) of the additional expenditures which arise from the imperfection of this method. In practice these requirements are actually not realized, which decreases substantially the efficiency of the use of the object-goal method. The broadening of the sphere of its use requires a reliable standard base.

The combined method of planning the expenditures on scientific research combines the base and object-goal methods. It is used in the plan of the financing of scientific research work of the institutes of the system of the USSR Academy of Sciences for 1976-1980. The sphere of use of the object-goal method was small--approximately a fourth of the total amount of expenditures of the wage fund. The opinion exists concerning the advisability of increasing the number of scientific trends and components, which form the material and technical base of scientific research institutes, for the development of which the resources should be planned by the object-goal method. There is a rational kernel in this suggestion. In the end its implementation signifies the gradual transition to the object-goal method of the planning of expenditures as such. However, in this case the emergence and development of the object-goal method of planning the expenditures on basic research will be realized as the result of uncoordinated decisions. The lack of integrity (completeness) in case of the changeover to the use of such a method adversely affects its effectiveness.

The direct changeover to the object-goal method of planning the expenditures on scientific research seems advisable. However, the mechanism of the changeover of scientific institutions to standardized planning should be multistage and should be based on the specific nature of concrete institutions and organizations. At the first stage at institutions of the academic type one should determine the total limit of expenditures, within which development is carried out, on the basis of consolidated standards which make it possible to determine the expenditures at institutions of the same time. Some stabilization of the standard should be accomplished by the use of an average

standard which has been calculated on the basis of the actual data during the five-year plan.

Under these conditions the possibility of the simultaneous consideration of several peculiarities of scientific institutions, which are contained, in particular, in the different ratio of the sources of financing of expenditures, appears. The calculations, which were made on the basis of a number of academic scientific institutions of the economic type, confirm the possibility of the introduction of standardized principles in the process of planning the expenditures of these institutions. The changeover to planning on the basis of the use of standards, which reflect the expenditures on each theme, should become the second stage of the changeover of scientific institutions to the object-goal method of planning. Here the consideration of the specific nature of the individual academic institutions assumes particular importance.

One of the shortcomings in case of the standardized planning of expenditures by themes consists in the proportionate distribution among them of the overhead expenses, while their amount can be different in case of the fulfillment of one theme or another. This is especially perceptible if some themes are performed with the use of expensive scientific equipment (it is necessary to maintain significant repair services), while other themes do not require such expenses. At the institutions of the Social Sciences Section the influence of this factor is being leveled. The degree of errors, which are introduced in the cost of individual themes, is approximately equal. Therefore in case of the determination of their planned cost the opportunity arises to use a standard, which was calculated as the ratio of the actual expenditures on similar operations, which were completed in past years, to the number of personnel who performed them.

In case of the planning of expenditures by themes the standard can be uniform for the organization or be determined for their groups. It is advisable to carry out the classification of themes by groups, incorporating in its basis the attributes which have the greatest influence on the labor intensiveness and cost of the operations. The ratio between scientific and auxiliary personnel, the level of vocational training and other factors, which have a significant influence on the amount of labor expenditures and, consequently, on the value of the standard, should find mandatory reflection within them. The gradual changeover to the standardization of the expenditures by themes on the basis of differentiated standards, which reflect the expenditures on the fulfillment of the individual stages of the themes being studied, should become the next stage of standardized planning. Depending on the stage of the conducting of the research the labor intensiveness changes as a result of the different need for auxiliary scientific personnel. The changeover to the use of differentiated standards will make it possible to increase the level of the planning of expenditures by themes. For its accomplishment standard cards, on which the planned and actual data on the cost and labor intensiveness of the themes being fulfilled should be reflected according to the stages indicated in the working plan, should be introduced as a mandatory form of reporting.

When analyzing the activity of scientific institutions the questions of the optimization of the personnel structure should become an object of closer

attention. Practical experience attests to the need for the improvement of the use first of all of auxiliary scientific personnel. The point is that a different need for the use of the labor of this category of associates arises depending on the stage of the conducting of research. The need for such labor increases in case of the gathering and processing of statistical information and decreases appreciably in the process of research. The times of the fulfillment of different themes do not coincide and the the opportunity arises for a kind of shifting of auxiliary scientific personnel among the sectors and departments of the scientific institution subject to the stages of the fulfillment by them of the given theme. This will also make it possible to meet more completely the need of each theme being fulfilled for auxiliary scientific labor without the additional increase of the staffs. The solution of these problems is especially important in light of the introduction of standardized principles in the practice of planning the expenditures on scientific activity. The ratio of the scientific and auxiliary scientific personnel has a very significant influence on the amount of the labor expenditures and, hence, on the value of the standard. In case of the changeover to the standardization of the expenditures by themes on the basis of differentiated standards, which reflect the expenditures on the fulfillment of individual stages of the themes being studied, the questions of improving the organization of the use of auxiliary scientific personnel assume particular importance.

The practice of the constant attachment of auxiliary scientific personnel to scientific associates without the proper coordination with the labor intensiveness and importance of the specific theme of research is prevalent at some institutions. Such a procedure gives rise to inequality in the workload of this category of workers during the fulfillment of the theme. A more sound approach to the organization of the use of scientific personnel will make it possible to intensify their labor significantly and to ensure the proper level of the work on the mobilization of the reserves of the increase of the effectiveness of expenditures on scientific activity.

For the increase of the flexibility of scientific institutions it is necessary to disseminate more extensively thematic subdivisions of a one-time nature, which are called upon to increase the goal orientation of research. The suggestion on the creation of temporary creative collectives in the system of the Academy of Sciences for the solution of urgent problems by the efforts of specialists of scientific institutions of different types should also be considered a development of this trend. It seems that such temporary creative collectives can also be set up (as needed) within a single scientific institution for the concentration of efforts on the solution of the most important problems which represent different research trends.

The importance of the increase of the flexibility of scientific institutions predetermines the need for the evaluation and consideration of such work when analyzing the activity of these institutions. In our opinion, the coefficient of the flexibility of the transfer of associates on the basis of the needs of the given theme can give a general description of the increase of the mobility and flexibility of scientific institutions. It should be determined in case

of the compilation of returns and the analysis of the activity of scientific institutions as the ratio of the number of transferred associates on the basis of the needs of the fulfillment of the given theme to their total number.

7807
CSO: 1814/98

TRAINING

SCIENTIFIC CADRE PREPARATION AT TALLINN POLYTECHNIC INSTITUTE

Tallinn RAHVA HÄÄL in Estonian 27 Feb 85 p 2

[Article by Ilmar Kleis, TPI vice rector for science, doctor of technology, professor: "Training of Scientific Cadres at Tallinn Polytechnical Institute"]

[Text] The basic task of an institution of higher learning is to provide certified specialists of the national economy. In addition, the institution must also train scientific cadres through internships and doctoral research. In view of the approaching TPI 50th anniversary it is appropriate to recall how the institution has managed to train technical and economic specialists, and to assess trends for the near future. Since TPI is the only higher technical institute in our republic, it is natural that TPI itself is the main user of technical scientists. Moreover, TPI is a relatively young higher technical institution, with teaching and research really getting underway only after the Great Patriotic War. For this reason problems of scientific personnel have been acute for decades.

The bourgeois republic's legacy for TPI was a rather small staff of technical scholars that was further reduced in the war's turmoil. For this reason instructors with technical degrees continuing their work immediately after the war could be counted on one's fingers. However, internships were established in the TPI as early as 1947, even though initially only in four fields (professors J. Kask, P. Kogermann, O. Maddison, and J. Vaabel served as advisors). In the 50's A. Aarna, A. Altma, A. Humal, L. Jürgenson, H. Laul, H. Lepikson, H. Raudsepp, and W. Treier joined the advisors. The number of accepted interns was small (an average of five a year). The turning point came in 1959 when 34 interns were accepted. This was caused by the sudden rise in entrants into the institution and the consequent need for instructors with advanced degrees. A total of nine new areas of specialization were established, with many successful lecturers in addition to the professor receiving the right to advise: J. Öpik (currently vice president of the ESSR Academy of Sciences, professor, doctor of technology), V. Kikas (currently TPI department head, professor, doctor of technology), H. Sillamaa, etc. In the 1960's 15 more fields of specialization were added, and another six in 1970. Currently TPI has internships in 30 areas, there are 47 advisors (21 of them doctors of technology). The number of fellowships has stabilized over recent years, hovering around 100. Non-resident students account for 60 percent of the total. All told, almost 500 candidates of science have been trained in TPI.

If in a scientific research institution highly qualified scholars are added only in some narrow specialty things as a rule are in order--strong research directions are established, scientific schools are founded, heterogenous research should even be condemned. In a teaching institution the situation is more complicated, since an instructor's field of study must be closely related to the subject taught. For this reason in TPI condition great emphasis is placed on directed internships where with the assistance of the higher learning institutions and scientific agencies of the fraternal republics precisely those specialties needed by the departments in their instructional process are covered.

The first five TPI graduates were detailed as fellows to Leningrad as early as 1951. Later, too, they have primarily been sent to institutions of higher learning in Leningrad. But detailed fellows have also studied in Moscow, Sverdlovsk, Kiev, Lvov, etc., and also in the Hungarian PR. To date the directed internships have produced almost 80 candidates of science, many of whom have become leading specialists of the republic (academician B. Tamm, professors H. Velner, V. Kulbach, A. Aitsam, L. Krumm, L. Paal, etc.) At the same time TPI's advisor professors have contributed to training of scientific cadres of the fraternal republic and the GDR in fields where we are in a leading position.

By 1977 the number of TPI faculty with advanced degrees was 66.1 percent of the total, higher than the all-union average, but still too small with regard to doctoral degrees (4.5 percent). In several departments the faculty's scholarly qualifications left something to be desired. Expert evaluations arrived at 72-73 percent as the optimal number of instructors with advanced degrees, to include 11 percent with doctorates. Measures were taken to reach the desired level. The primary task was to improve the training of doctors of science. A joint decision of the TPI council and party committee implemented a plan regarding remedial steps. Its main points called for providing doctoral candidates with needed equipment, priority conclusion of scientific work contracts, dispatching candidates abroad for training, and limiting their teaching and social commitments to the maximum amount possible. Deans and department heads were mandated to systematically survey the course of the dissertations, and were also asked to plan who should in the near future be dispatched to doctoral research for the final refinement of the dissertation. Expert analysis indicated that the number of doctors in TPI could be increased by 12 to 15 over the next 3 to 4 years, and by the same number in subsequent years.

Both the researchers themselves and the experts were too optimistic as far as target dates went--from 1980 to 1982 only three members of TPI faculty defended their doctoral dissertations. Among the main reasons for delay one should mention the dissertation committee's much stricter attitude toward the publication and implementation of research results, something that demands more time and effort, especially in applied research. Many a doctoral candidate showed resignation tendencies. At the initiative of TPI administration, primarily of Professor H. Lepikson, vice rector for science, additional measures were drafted in early 1982, the so-called intensive method. All 11 of the most promising doctoral candidates compiled a detailed calendar plan for

conclusion of the dissertation. Department heads were asked to place only minimal burdens on the candidates for two semesters. The requirement for immediate contact with institutions that could be considered as future sites for defending the dissertation was established, as well as the requirement to publish research results in central journals and abroad. Every semester the candidates reported to the TPI council on the progress of their work. Among both the candidates and their surroundings the conviction grew that their work was just as important to TPI and our national economy as for the writers of the dissertation. In 1983 five dissertations were defended, four were presented for review (as an explanation--due to various procedural rules, examination schedules and the need to make revisions in the dissertations about a year passes between the presentation of the dissertation and the actual defense). In 1984 the corresponding figures four and four. This year at least four dissertations are to be defended. In summary it can be said that one of the aims established in 1977--to increase the percentage of faculty with advanced degrees to 73--has been reached. There is still a lag in the proportion of scientific cadres with the highest qualification (at the moment there are 46 doctors of science and professors in the TPI, representing 7.7 percent of the total number of faculty).

The same problems that face TPI occur in the USSR higher education system as a whole. Of the 470,000 scientific personnel working in the USSR Higher and Specialized Secondary Education Ministry 3.9 percent are doctors of science and 41.3 percent candidates of science. The task is not simply to increase the qualifications of scientific personnel in any way possible, but to do it primarily in the new and promising fields of science (electronic computers, microprocessors, robotics and manipulators, management of science, economies, education, psychology, etc.) Unfortunately, there is not a single staff member with a doctoral degree in the TPI automatics department where the above-mentioned technical fields are primarily explored. To be sure, docents H. Sillamaa and O. Aarna have completed their dissertation, but the defense has been postponed for several reasons. Of course the TPI staff will be guided by the directives of higher organs and will in the future place the main emphasis on promising fields of science.

In the training of scientific cadres further bottlenecks have become apparent; these were discussed on 8 January in RAHVA HAAL by the deputy chief of the ECP Central Committee's science and school department, V. Rajangu, doctor of economics. The effectiveness of internships must be improved. In training doctors little attention has been paid to the candidate's suitability for working as the chief of the collective (department, research project). At the moment there is a paradoxical situation in TPI--only 16 doctors are heading departments. The average age of doctors is increasing.

During the current 5 year period the TPI collective has had some success in training qualified scientific cadres, but it is also aware of shortcomings. By continuing to put planned measures into effect we hope to liquidate the fundamental shortcomings during the next 5 year period. In this way we will make our contribution to the progress of our society's science and technology.

9240
CSO: 1815/29

AUTOMATION AND INFORMATION POLICY

AUTOMATION OF RESEARCH AT KAZAKH ACADEMY OF SCIENCES

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 12, Dec 84 p 3

[Article: "On the Status and Improvement of the Work on the Automation of Scientific Research"]

[Text] In recent years the Presidium of the Kazakh SSR Academy of Sciences has devoted much attention to the questions of the automation of scientific research (ANI). In 3 years of the current five-year plan about 100 computers of different classes, displays, hardware in the standard of KAMAK and other equipment have been received and distributed among the institutions of the Kazakh SSR Academy of Sciences. On their basis development on the automation of scientific research is being conducted at a number of institutions of the academy, in particular, mathematical models of the objects being studied, packages of applied programs for data processing and systems of the control of scientific experiments on a real time scale are being developed.

The Council for Automation, Computer Technology and Scientific Instrument Making attached to the Presidium of the Kazakh SSR Academy of Sciences has done considerable work on planning and coordination, the improvement of the supply with hardware and software of the automated systems of scientific research (ASNI's), the increase of the skills of specialists and the organization of conferences and schools.

At several institutions (the Institute of Nuclear Physics, the Institute of Metallurgy and Ore Dressing, the Institute of Mining, the Institute of Geological Sciences, the Institute of Chemical Sciences, the IIAiE [possibly--Institute of Kazakh SSR Academy of Sciences] the organization of the corresponding services contributed to the acceleration of development and the introduction of automated systems of scientific research. By now the most effective automated systems of scientific research have been developed at the Institute of Nuclear Physics and the Institute of High Energy Physics of the Kazakh SSR Academy of Sciences. The Institute of Mathematics and Mechanics of the Kazakh SSR Academy of Sciences has made on computers of the collective-use computer center (YeS-1022, YeS-1045) scientific and technical calculations for 15 institutions of the academy. However, in several departments and institutions proper attention is not being devoted to the questions of the automation of scientific research and to the efficient use of computers.

The cooperation and coordination of operations among the institutions of the academy are being carried out inadequately, and in a number of case the decrees of directive organs are being implemented late.

The Presidium of the Kazakh SSR Academy of Sciences notes definite changes in the work on the automation of scientific research at the institutions of the academy, which is being conducted under the supervision of the Council for Automation, Computer Technology and Scientific Instrument Making attached to the Presidium of the Kazakh SSR Academy of Sciences.

The academician secretaries of the departments and the directors of the institutes of the Kazakh SSR Academy of Sciences need to take steps for the elimination of the shortcomings and the intensification of the work in the area of the automation of scientific research.

For the improvement of the cooperation, coordination and planning of operations in the area of the automation of scientific research, as well as the increase of the efficiency of the use of computers and the hardware of the automated systems of scientific research with the growth of new developments it is proposed to organize in the structure of the Council for the Study of Productive Forces a department of the problems of the automation of scientific research and computer technology.

7807
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AUTOMATION AND INFORMATION POLICY

GOMEL SCIENTIFIC, TECHNICAL INFORMATION CENTER

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 85 pp 14-15

[Article by I. I. Kulikovskiy, director of the Gomel Intersectorial Territorial Center of Scientific and Technical Information and Propaganda: "The Reserves Have Not Yet Been Exhausted"]

[Text] The Gomel Intersectorial Territorial Center of Scientific and Technical Information and Propaganda (TsNTI) was founded in 1977. Now its holdings number about 1 million information records, patent, standard technical and design documents and catalogues. More than 1,300 enterprises and organizations are constantly cooperating with the center. I. I. Kulikovskiy, its director, writes about the experience of the work of the center, the problems and difficulties.

We regard as our main strategic goal the increase of production efficiency on the basis of scientific and technical progress. There is a large field of activity for this. Gomel Oblast is one of the major industrial centers of the country.

The collective of the center is aiming the basic efforts at the complete and prompt information supply of the enterprises and organizations of industry, agriculture and construction with the latest achievements of science and technology and at the introduction of these achievements in production. We are coordinating our work with the scientific and technical information services locally, the oblast councils and sectorial boards of scientific and technical societies, with the All-Union Society of Inventors and Efficiency Experts, the oblast board of the Society for Knowledge and the public councils for the promotion of technical progress. The Gomel Intersectorial Territorial Center of Scientific and Technical Information and Propaganda has established and maintains bilateral contact with all the all-union, republic, central sectorial and territorial organs of scientific and technical information of the country.

In order to fulfill most completely and promptly the tasks assigned to it, the collective of the center has determined for itself the basic directions of work. We are striving to increase the level of information-reference service and to improve the promotion of scientific and technical achievements.

All the measures on scientific and technical information and propaganda are aimed at the solution of the urgent problems of the reduction of manual labor, the increase of the technical level of production, the saving of fuel and energy resources and the introduction of advanced forms of the organization of labor. In 1983 as a result of the use of information materials for the oblast as a whole 4,604 innovations with an economic impact of 20.9 million rubles were introduced, including in accordance with sources of the Gomel Intersectorial Territorial Center of Scientific and Technical Information and Propaganda--1,241 innovations with an economic impact of more than 10 million rubles.

During this five-year plan 20 union comprehensive goal programs and programs on the solution of the most important scientific and technical problems are being implemented in our oblast. Their performers are 27 enterprises and organizations. Of course, production collectives, scientists and planning and design organizations are performing the bulk of the work. But it is difficult to overestimate the importance of information support in the fulfillment of the programs. Therefore we have taken care to additionally include in the thematic plan of the making up of the information-reference holdings such themes as the introduction of robots and manipulators and the methods of powder metallurgy, the automation of the control of technological processes and others. Themes of an exclusively sectorial nature, which are connected with the solution of the problems of the scientific and technical programs, have been included in the plan of the making up of the United Territorial Information-Reference Holdings (YeTSIF).

In our oblast particular attention is being devoted to the further mechanization and automation of production processes and the elimination of manual and physically difficult labor. The enterprises of the machine tool building, metalworking, chemical and pulp and paper industries and others have achieved the highest level of the mechanization of labor and accordingly a lower proportion of those employed in manual operations. Specialists of the center of scientific and technical information also gave them help in this.

We are constantly selecting information on scientific and technical innovations and are preparing for enterprises thematic collections and lists of mechanisms, devices and accessories, which have been introduced at enterprises for the purpose of mechanizing manual labor. The center of scientific and technical information also publishes the posters "Manual Labor Onto the Shoulders of Machines," which tell about the advanced know-how of the plant of starting motors, the Gomel'kabel' and Emal'posuda plants, the plant of machine tool assemblies and others. Materials on the theme of the reduction of manual labor are systematically published on the pages of the newspaper HOMEL'SKAYA PRAWDA and are broadcast over oblast radio and television. The information leaflet "The Experience of the Work on the Reduction of Manual Labor in Industry of Gomel Oblast" was published by the center.

The work of the scientific and technical information services at enterprises and organizations is contributing in many ways to the acceleration of scientific and technical progress and the increase of production efficiency. Our center is giving them procedural assistance in the improvement of

information activity and scientific and technical propaganda. The scientific and technical information services of the plant of starting motors, the Emal'posuda Plant, the plant of measuring instruments and the oblast Vodokanal Production Association are working most fruitfully.

At the Gomel Plant of Starting Motors, for example, the work of the group of expert reviewers, who carry out the purposeful selection and introduction of the achievements of science and technology in production, has been set up in an exemplary manner.

The Gomel Emal'posuda Plant for 15 years has been using a system of the material stimulation of personnel for the selection and introduction of innovations which have been taken from sources of scientific and technical information. This makes it possible, on the one hand, to increase the interest of specialists in this work and, on the other, to increase the economy effectiveness from the use of scientific and technical achievements and innovations.

Of course, not all enterprises and organizations can venture to have a well-manned staff of technical information workers and experts. Many specialists, who combine jobs, are coping rather well with their duties. It is important merely that economic managers, chief specialists and public organizations would help them. At the same time the reduction of staffs at the expense of the scientific and technical information services is not always justified. According to the recommendations of the USSR State Committee for Science and Technology the number of information personnel at industrial enterprises should come to 1-2 percent of the total number of engineering and technical personnel. With less than 50-100 engineering and technical personnel the scientific and technical information service should be organized by the combining of jobs, while at small enterprises it should be organized as a public service.

It should be noted that at the majority of enterprises of the oblast these recommendations, which were spoken about above, remain unfulfilled. Even at leading and large ones the staff services come to 0.3-0.7 percent of the number of engineering and technical personnel. In the past 2 years alone the number of such services has decreased from 93 to 81. The Gomel'kabel' Plant, the motor vehicle repair plant and Construction Trusts No 7 and No 14 do not have them. The experience of scientific research institutes, design bureaus and planning and design bureaus, at which the staff structures of the scientific and technical information services became more stable after their removal from the administrative and management personnel, suggests a way out of the formed situation. Apparently, the need has also arisen for the transfer of such services in the sphere of production from the administrative and management personnel to the production personnel.

The formation of an "ascending flow," that is from enterprises and organizations to intersectorial organs of information, is of great importance in the organization of the use of scientific and technical achievements. Much still has to be done here. In 1983 manuscripts for the publication of information leaflets were received from only 35 enterprises of industry and 20 enterprises of agriculture of Gomel Oblast. The center of scientific and

technical information annually receives about 4,000 information cards for new items, technological processes and methods of the organization of production and labor. However, the enterprises and organizations of the oblast are also represented here entirely inadequately: information cards are drawn up for only approximately 20 percent of the innovations introduced in production.

The increase of the level of the information supply of workers of agriculture is one of the vital problems facing the scientific and technical information services. On this level the center jointly with the administration of agriculture of the oblast soviet executive committee is performing definite work. We are constantly making a selection of innovations and scientific and technical achievements from the materials of our holdings and are sending them in the form of thematic collections, current awareness information and information leaflets to enterprises and organizations of agriculture. We are helping to set up scientific and technical information bureaus at kolkhozes and sovkhozes and are giving advice on how to perform this work better. There are many farms at which they have set to work with spirit and interest. At the Krasnyy Oktyabr' Kolkhoz of Dobrushskiy Rayon and the Iskra Kolkhoz of Zhlobinskiy Rayon, at the Vedrich Sovkhoz and the rayon administration of agricultural chemistry of Rechitskiy Rayon the study and selection of innovations from various sources of information are constantly being carried out. Many of them are then used in practice.

However, as a whole the state of scientific and technical information at kolkhozes and sovkhozes does not meet the requirements of the Food Program. The basic reason is that the attention to this question on the part of the republic Ministry of Agriculture has been relaxed. The fulfillment of the joint decree of the Belorussian SSR State Planning Committee and the Belorussian SSR Ministry of Agriculture on the improvement of the system of scientific and technical information in agriculture of the republic should be approached more rigorously, the responsibility of the workers, who are accountable for the state of scientific and technical information, should be increased and the necessary assistance should be given to them.

Soon the Gomel Intersectorial Territorial Center of Scientific and Technical Information and Propaganda will significantly strengthen its material and technical base. The construction of a five-story laboratory production building is being completed. With its placement into operation the conditions of all information work will be improved significantly. A conference hall with 400 seats, a movie theater with 100 seats, a reading room and an exhibition room, rooms for copying and duplicating equipment and the mechanized retrieval of information, depositories for the information-reference holdings and other special rooms are envisaged in the new building. This will help us to work even more productively, with a greater output.

7807
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INTERNATIONAL S&T RELATIONS

TASHKENT HOSTS BLOC COMPUTER CONFERENCE

[Editorial Report] Tashkent PRAVDA VOSTOKA in Russian on 13 March 1985 carried on page 3 a 100-word UzTAG article titled "Reliability for Computers" announcing the opening on 12 March in Tashkent of the 3rd international meeting of the temporary working group on the reliability of small computer systems. The meeting is being conducted by the council of chief designers of the interstate commission for cooperation among the socialist countries in the area of computer technology. Representatives of participating countries -- Bulgaria, Hungary, GDR, Cuba, Poland, Romania, the Soviet Union, and Czechoslovakia -- will be discussing topical problems in improving computer technology and in improving the technical and economic indicators of systems and complexes.

[Editorial Report] Tashkent PRAVDA VOSTOKA in Russian on 15 March 1985 carried on page 3 a 200-word UZTAG article titled "Reliability for Computer Technology" announcing the closing session of the 3rd meeting of the temporary working group on the reliability of small computer systems on 14 March in Tashkent. D.P. Lebedev, head of the temporary working group and sector chief at the Institute of Electronic Control Machines, noted that the exchange of opinions was useful. "The problem of computer reliability is particularly critical right now. It is important that mass-produced computers work under all conditions without requiring highly specialized programmers. We are working with representatives of the CEMA countries to achieve uniformity in approaching the production of such machines." The laboratory director of Bulgaria's Institute of Computer Technology, V. (Raychev) expressed his impression that Uzbekistan was devoting great attention to the creation of computers and added that the meeting aided in the exchange of experience in developing new models of reliable and economic computers.

CSO: 1830/493

ADVANCED TECHNOLOGY SEEN AS AREA OF US-JAPAN-WESTERN EUROPE RIVALRY

For more on this subject, see article by Fedor Burlatskiy: "The Technological Revolution and the Ethics of Robots," LITERATURNAYA GAZETA, 31 Oct 84 p 14 in JPRS UPS-84-109, 11 Dec 84.

GENERAL

LEVELS, DISCIPLINES OF SCIENCE

Moscow OBSHCHESTVENNYYE NAUKI in Russian No 6, 1984 pp 89-99

[Article by Candidate of Philosophical Sciences Pavel V. Smirnov,* senior scientific associate of the Institute of the History of Natural Sciences and Engineering (IIYeiT) of the USSR Academy of Sciences: ""The Level and Disciplinary Structures of Science"; passages rendered in all capital letters printed in italics in source]

[Text] The basic points, which an idea passes through in its movement from the abstract to the concrete and vice versa, characterize three levels of research--basic, applied and developmental. We will arbitrarily call them "level research."

Moving from one level to another, an idea also does not remain invariable in the disciplinary respect. The fundamental fact of the unity of the space-time parameters of any, including scientific, activity is reflected in the contingency of the level and disciplinary changes. The proportions--level and disciplinary--are established as a result of the effect of complex and entirely unrealized forces. Much depends on traditions, on what field of science was promising in the recent past, and, of course, on the talent of scientific personnel, on the quality of so-called expert appraisals and so forth.

A quantitative theory of the optimization of all the elements of the structure of science--level and disciplinary--merely has to be developed. Being the immediate business of a new discipline--the science of science--it is at the same time also its main socioeconomic justification. Many difficulties still have to be overcome. Take if only the classification of level research itself.

In connection with the relative decrease of the share of the creative principle in the structure of activity with its movement toward production and the increase of the extent of its reproductive component the temptation arises to take development beyond the framework of research. The "separation" of development from research seems logically illegitimate to us. The final stage of the movement of an idea from the abstract to the concrete, although different from the stages preceding it, remains entirely within the framework which contains research.

The "component" basis of any research is formally identical everywhere. And in this sense there is no difference between basic, applied and developmental research. But from the point of view of combinatorial analysis the difference between them is significant, since, while not differing from each other in the components, the research differs in the distribution and configuration of these components. Thus, the "purity" of each of the levels is not complete, for it is nothing more than the dominant line in the distribution of the basic components. Each level is thereby some set, some statistics of different types of research.

The levels, being inherent in science genetically, that is, by birth, are clearly traced only at a specific stage of both science's own development and the strengthening of its contacts with society. The maturity of the interaction of science with industry and agriculture is very important here. Precisely the intensive increase of the scale of the practical utilization of scientific achievements, which began in the last century, led to a change of not only industrial and agricultural technology, but also science itself. The key phases of the cognitive-experimental process since that time have been shaped organizationally into level research.

While the applied and developmental stages of science were undeveloped, the function of the basic stage inevitably reduced, in essence, to the explanation of what is. But with the development of science and the strengthening of its contact with production the function of transformation was brought to the forefront. First of all technology was, of course, at the heart of this process. Both in the sphere of production and in the sphere of science it outgrew the possibilities of the traditional forms of its development--the empirical and the handicraft forms. Precisely for this reason new technology is able to unite the previously uncoordinated functions--explanation and practical transformation.

K. Marx noted and formulated this radical turn in the orientation of science and the shift of its main attention from explanation to practical transformation for the first time in the famous 11th thesis on Feuerbach: "Philosophers EXPLAINED the world merely in a different way, but the thing is to CHANGE it."[1] Long years were to pass before it became possible to address the idea of Marx, which was addressed to philosophy, to all private scientific knowledge. This work has also been conducted for many years now in our country; the June (1983) CPSU Central Committee Plenum, which demanded the fundamental turn of the social sciences toward the real, practical tasks of the building of socialism, should be considered the turning point.

The origination of the present level structure of science, just as its present disciplinary system, is a complex process of the counter movement of opposite lines--the line, which runs from practice to science, and the line, which runs from science to practice. As a result modern science in the true sense of the work is also emerging. Its similarity with science of the past, especially the distant past, is purely nominal.

Social relations should also be adjusted to the historically forming structure of modern science and to the saturation of production with science. Thus, special subdivisions, each of which would perform strictly specified functions

on the organization of the scientific process and the introduction of its results in practice, should emerge. Qualitatively new socioeconomic forms of the organization of the scientific process, which are characteristic only of socialism, should be sought.

To combine the achievements of the scientific and technical revolution fundamentally with the advantages of the socialist economic system means to solve a problem of historical importance. It is impossible to overestimate the importance of this fundamental party precept, which is aimed at the search for and the practical use of specifically socialist forms of the organization of science and the universal introduction of its results.

The concern for the development of BASIC RESEARCH in our country rests mainly with the USSR Academy of Sciences and universities. The organization of affiliates and bases of the academy marked the beginning of much work, which led to the formation of national academies of sciences and scientific centers in all the union republics. The need to distribute scientific forces more efficiently throughout the country, to coordinate them more closely with local conditions of the development of the economy and to concentrate physical, manpower and financial resources gave rise to the idea of their organization. It expressed the need of the forming "science--industry--agriculture" system for organizational forms which were equivalent to it.

The Siberian Department of the USSR Academy of Sciences was founded in 1957. Three principles were the basis for its activity: the extensive development of basic research, active participation in the solution of cardinal problems of practice and the combination of research activity with the training of personnel. The Siberian Department is playing a large role in the development of Soviet science and in the progress of productive forces in the eastern regions of the country.

For the purpose of the closer and more efficient interaction of basic and applied research regional scientific centers were set up and underwent development on the territory of the RSFSR: the Ural and Far Eastern academic centers, the North Caucasian Center of the higher school. The Leningrad Scientific Center of the USSR Academy of Sciences was founded in 1982. The organization of these centers led to the significant increase of the role of the Academy of Sciences in the system of scientific activity of the country.

APPLIED (SECTORIAL) RESEARCH underwent rapid development back during the prewar years in connection with the large-scale construction of giants of heavy industry. The sectorial scientific research network was developed especially intensively in postwar times in connection with the start of the mass transformation of science into an immediate productive force.

Now about 800,000 scientific associates are employed at sectorial scientific research institutes and experimental design bureaus (that is, 16-fold more than at the USSR Academy of Sciences). If we keep in mind that the achievements of academic science and science of higher educational institutions are realized mainly through sectorial institutes, it is possible to conclude: the sharp increase of the level of the sectorial sector of science has become today one of the main factors of the acceleration of

scientific and technical progress. It is a question of the closer cooperation of sectorial scientific research institutes with each other, and of sectorial science as a whole with the national economy, of the assurance on this basis of the comprehensiveness of research.

Associations are an important component of the organization of scientific and technical progress. They are becoming today an essential unit of the organizational structure of the national economy. Two types of associations: the scientific production association (NPO) and the production association, operate in the USSR. The former--the plant sector of science--is called upon to conduct DEVELOPMENTAL RESEARCH, to develop models of new industrial and scientific experimental equipment; the association of the latter type ensures the copying of new products, including new equipment, and their operation.

Educational scientific production associations are also being developed. With their organization it has become possible not only to link more closely the training of highly skilled specialists and the solution of specific problems of science and technology, but also to use more completely for practice at large the scientific potential of instructors, graduate and undergraduate students. Experience attests to the great economy efficiency of such associations.

The advantages of associations over simple enterprises today are clear to everyone, and still the process of their formation is proceeding more slowly than was anticipated.

The creation of highly efficient scientific production associations requires the elaboration of adequate socioeconomic principles of the functioning of each of its parts, which ensure their optimum interaction, and the development of a set of corresponding indicators. Thus, the simple transfer of scientific research institutes to production associations frequently leads, as practical experience shows, to the decrease of the efficiency of the scientific research institutes and to the sharp decrease of both the number and the depth of the research problems being solved. Moreover, the modern scientific production association is inconceivable without profound changes in the production process itself. First of all a new scientific and technical base should be placed under associations. Anticipation in the matter of organizing scientific production associations, which is not backed by the corresponding scientific, technical and socioeconomic measures, always leads to the decrease of production efficiency.

It can be safely said that we will increase sharply the efficiency of all science, if we are able to achieve quickly the maximum specialization of its individual subdivisions and free each of them from functions not characteristic of it and if, finally, we strengthen everywhere and properly the cognitive-transformational process organizationally, especially as the leading trends fully revealed themselves in the development of the organizational structure of science and its contact with industrial and agricultural production.

Thus, the changes occurring today in the level structure of science should resolutely and opportunely be supported organizationally, by striving to

concentrate basic research at academic institutes, applied research at sectorial institutes and development at scientific production associations. Only the concentration of each of the levels primarily on one function ensures their great efficiency.

At the same time one must not carry to the point of absurdity the drive for "pure" lines in level research. For example, one should not attempt to "close" in academic institutes any applied or developmental research. Such an intention, apart from all else, would be impossible to realize, since problems, which pertain to a different level, sooner or later arise within any study. Such is the law of the internal development of science.

From the need for the maximum differentiation of level research there follows just as strict a need for its maximum cooperation and integration. Today the so-called comprehensive programs of scientific and technical progress are called upon to play this integrating role.

After generalizing the gained experience, the party proposed to use extensively the goal program methods of the organization of scientific and technical progress (NTP), orienting it toward the most important problems of the economy. As a result the comprehensive approach to these problems is becoming the rule. As is known, the basic assignments on 170 comprehensive programs, including the food, energy and resource-saving programs and so on, were included in the plans of the 11th Five-Year Plan. They encompass the entire path from basis research to applied research, from the development of new equipment to its industrial assimilation. The plans drafted by the USSR State Planning Committee, the USSR State Committee for Science and Technology and the USSR Academy of Sciences envisage the assimilation in the national economy of the most valuable, radical scientific and technical achievements.

Such programs do not replace and cannot replace the three-unit structure of the organization of scientific and technical progress--basic, applied and developmental research. Moreover, they presume its consistent further development. The comprehensive approach, in which not only different disciplines, but also different levels of research are united, proves to be effective only on such a basis.

The present form of the comprehensive organization of Soviet science is based on historical experience, and first of all on the experience of the solution in the USSR of two extra difficult problems--the conquest of atomic energy and the development of space. The importance of the state organization of science under socialism appeared in the successful solution of both problems and in the rapid and broad advance of the fundamentally new organizational results, which were obtained here, into all fields of science and technology.

And all the same until recently the comprehensive organization of scientific and technical progress was a rare phenomenon, and not the norm. It is becoming a norm, a law precisely in our times under the influence of the needs of modern practice and science. This indicates the entry of science into a new historical phase of its own progress. Before examining the features of the mentioned phase, let us return to the assumption, which was formulated at the beginning of the article, concerning the contingency of the change of the

disciplinary and level components of science and reveal it. This will help to see in a new way both the history of the interaction of the sciences and their current state.

While agreeing that the organizational unit of science is an exclusively historical phenomenon and therefore appears differently at different times, it should be added that in its logical essence this unit of science all the time remains a constant, which is equal to itself. The name of such a unit is the PROBLEM.

In order to reflect the specific nature of the problem in an organizational form equivalent to it, it is necessary to introduce another, in our opinion, fundamental parameter--its SPACE-TIME METRIC. The spatial component of the metric characterizes science (the problem) as viewed from its disciplinary composition and records the geometry, the radius of the necessary division of labor in it. The temporal component of the metric characterizes the level structure of science (the problem), that is, expresses the movement of an idea from the abstract to the concrete, and vice versa. Both components of the metric are conjugate, and therefore changes of the disciplinary system of science entail changes of its level structure, and vice versa. Thus, the specific nature of each problem--the disciplinary and level nature--is reflected in the specific nature of the metric of its conception, statement and solution. But inasmuch as the development of science is the process of the successive change and complication of problems, during such development the metric of its existence and functioning of necessity also changes: the time of the solution of newly arising problems speeds up and the space of their solution expands. This is also the original cause of the organizational rearrangements of science, the emergence and spread of some historical forms of it or others. They prove to be as if strung to the metrics of problems.

If we now look at the history of the interaction of the sciences through the metric prism, we will see that the idea in its movement from problem to problem always plots some problem field, the space of which is constantly expanding. Initially it does not exceed the space which is characteristic of the subject of one discipline or another. Moving whimsically within the indicated space, the scientific idea draws in it the basic structural lines and reveals the greater and greater diversity of the means of its existence. The classical monodisciplines--mechanics, physics, chemistry, biology and so on--originate precisely during this period.

However, as the reserves of the isolated monomovement are exhausted, the space of an active idea becomes larger than the space of one individual monosubject or another. And in it the scientific idea starts its own new points of growth, around which the first interdisciplinary formations emerge, such as, for example, physical chemistry, chemical physics, biochemistry and so forth. Then, having exhausted the possibilities of the isolated development of these new formations as well, it is concentrated on new points of growth--multidisciplinary formations, which encompass entirely or partially such large areas as the natural sciences or the social sciences. Now the space of its movement already exceeds by many times the space of the separately taken classical monodiscipline. Finally, starting somewhere in the middle of the

19th century the above-named large fields of knowledge also prove to be narrow for it, and it forms the general scientific space.

As a result we work most often "on problems, without taking into consideration the scientific framework."[2] Each discipline specializes under these conditions in deliveries of some ideal product for all the other fields of knowledge. Thus, the comprehensive organization of science reflects nothing other than the strong predominance of the process of the integration of the sciences over their differentiation, which dominated in past centuries.

More and more serious reasons for the conjugation of space-time in the social sciences, and first of all in economic science, are appearing at present. The main one of them is the need for the measurement and (on this basis) the breakdown of the activity of modern man. The old mechanisms, which served this goal, are more and more noticeably exhausting their measuring resources. It is necessary to think about the development of new mechanisms, which would be capable of increasing sharply both the differential precision and depth of the measurement of the parameters of labor and the levels of the integration of all its individual components into a new unified whole. The transformation of science into an immediate productive force is impossible without the optimum distribution of scientific and technical activity both in space (the configuration and structure of the division of labor) and in time (the cooperation of labor). Therefore the interpretation of the internal connection of the space and time, which are inherent in labor and express it, of the interaction with each other of their historically different forms, on the one hand, and, on the other, of the interaction of each of them with their logical, that is, universal, form also constitutes, in our opinion, the basic content of the new step in the development of the theory of the measurement of activity. Today both the further progress of production and the progress of science itself in many ways depend on this.

By speaking about the fact that there is inherent in every problem its own metric, we are recognizing first of all some objectively necessary space-time, within which it is solvable. The question arises: Does the random metric, within which only individual activity is capable of developing, coincide with it? Only the successful experiment makes it possible to answer it. However, this fundamental function of the experiment in the natural sciences has remained up to now in the background, which in general is understandable, since here it is only the "duty" of the experiment to verify hypotheses, turning or not turning them into a theory. The question of its role in the identification of the random and necessary metrics simply does not arise, since in the natural sciences they are no longer even differentiated. Political economy long ago made such a differentiation and traditionally engages in the study of the mechanism of their identification. However, it does not see in this mechanism an immediate relative of the natural science experiment. Their common character is coming to light only in our times, when the long-range trends of the development of science prove at the same time also to be the most economically profitable trends of economic activity. Only now has it become possible to see in the classical natural science experiment not only the mechanism of the turning of a hypothesis into a theory, but also the mechanism of the identification of the individual and the socially necessary metrics, while in the classical political economic act of

"buying and selling" to see not only the mechanism of the reduction of the individual space-time to the socially necessary space-time of the production of some good, but also the experimental confirmation of some economic hypothesis and its conversion into a theory.

Thus, the real problems of the further development of both science and physical production bring traditional experiments into interaction with each other, integrating them into one "large" experiment. Therefore not the ordinary scientific experiment in the traditional monodisciplinary form, but a fundamentally new, multidisciplinary experiment is taking the place of the empirical act of "buying and selling," in which the degree of coincidence of both metrics was previously verified. All three fields of knowledge--the social, natural and technical sciences--are taking part in its assurance. The question of the coincidence of the individual and the socially necessary metrics thereby encompasses both the economic and the natural science spheres. Thus the problem of the measurement of activity is turning from an exclusively economic problem into a general scientific global problem.

The problem field contains two essentially different groups of problems. First, there are problems which in principle are solvable. They in turn are divided into urgent problems, that is, ones which are objectively ripe for solution and therefore are already developed in the socially necessary space-time, which it remains merely to "open," to realize, to organize and so forth, and into potential problems, which are capable of existing only in the individual space-time metric, for objectively they are not yet ripe for solution. The number of potential problems always significantly exceeds the number of urgent problems. Second, there exists a mass of quasiproblems--the result and at the same time the criterion of the degeneration of some scientific trend or another.

Of the whole array of components of the problem field only the problems, which are objectively ripe for solution, contain all the energy for the further movement of science. Therefore their resource supply enables the mental process to develop after the pattern of the "chain reaction," of which, as is known, the maximum excess of the final energy over the initial energy is characteristic. As applied to science this means not only the return of the initial expenditures in amounts, which exceed them by many times, but also the development of science at the fastest rate, in the maximum possible directions for its given state, and, finally, the creation of the most favorable conditions for the conversion of a larger and larger number of potential problems into urgent problems. Otherwise scientific and technical progress either slows down or halts altogether, and society does not obtain a return from the made expenditures.

If there were inherent in each of the named groups of problems its own obvious indicators--peculiar metrics, it would be no trouble to move science ahead. However, such obvious indicators and metrics do not exist in nature. And therefore the task of the differentiation of problems in the problem field was, is and will be extremely complicated.

First of all man himself acts as the main factor of such differentiation. The idea, which moves in the problem field, is nothing but an abstraction. In

life it is always represented by a specific person, some individual or another. In science this is all the more correct. In reality, the success or failure of any study begins with the choice of the problem (theme). This choice always is and will be arbitrary, free and therefore does and will contain the possibility of a mistake. The probability of the successful choice and solution of a problem is proportionate to talent. Given its maximum it is close to one, given its minimum it is close to zero.

The coincidence in time of two historical processes: 1) the conversion of science into an immediate productive force; 2) the formation of a harmoniously developed individual in the process of the building of communism, is thoroughly symptomatic. The latter of the named processes as an important goal of the movement toward communism is also the only means of movement of science. At the same time the achievement of the truth as the goal of science is the basic tool of the creation of a new society and a new man.

The sharp increase under present conditions of the share of the completeness of knowledge is also posing in a new way the problem of the training of personnel. The need is arising to shift the ratio of general and special disciplines so that the future specialist would be capable of quickly acquiring new knowledge and of mastering nontraditional methods of research. It is not as easy to do this as might seem at first glance.

We are now attempting to determine the place in the problem field of science, the application of forces to which would ensure its maximum efficiency. It seems that the problem of this sort is analogous to the problem of finding the area of preferable capital investments or the area of the great effectiveness of capital investments. While the frequency of discoveries in a new scientific field remains greater than the frequency of discoveries in other fields, the influx of new forces continues in it. When these frequencies equalize, the stabilization of the personnel occurs. Given the decrease of the frequency of discoveries to less than the average frequency in science the outflow of researchers begins. This field turns from a "point of growth" into a "point of stagnation." However, if the decrease of the number of discoveries coincides simultaneously with the increase of the number of theoretical anomalies--experimental factors which do not fit into the theory which was developed on the basis of a specific idea, this means that this field is on the verge of its radical transformation, revolutionary changes and the formation of new "points of growth."

Thus, the frequency of scientific discoveries and anomalies is a correct criterion for the proper distribution of resources both among different scientific disciplines and within each of them and among different level studies. The most important, if not the old, forecasting task of the theoretical science of science is the development of an overall picture of the distribution of the frequencies of discoveries and anomalies in the entire problem field of science. Such an analysis--let us call it a frequency analysis--will make it possible to depict science as problem fields of different efficiency, which in one way or another interact. It is especially important to distinguish here two fields. One of them emerges as a result of the movement of a science idea PRIOR TO the formation of a "point of growth," that is, a fundamentally new discovery, while the other emerged AFTER it. The

minimum frequency of discoveries and the maximum frequency of experimental anomalies correspond to the former, and, on the contrary, the maximum frequency of discoveries and the minimum frequency of experimental anomalies correspond to the latter. One of them swallows up the resources of society, promising, however, with time to repay them a hundredfold, the other already at present is giving society much more than it consumes.

FOOTNOTES

*P. V. Smirnov is the author of works on the problems of the science of science. The published article was prepared on the basis of a chapter of the collective monograph of the Institute of the History of Natural Sciences and Engineering "Vzaimodeystviye nauk (teoreticheskiye i prakticheskiye aspekty)" [The Interaction of the Sciences (Theoretical and Practical Aspects)], Moscow, "Nauka", 1984.

1. K. Marx and F. Engels, "Soch." [Works], Vol 3, p 4.

2. V. I. Vernadskiy, "Uzbrannyye trudy po istorii nauki" [Selected Works on the History of Science], Moscow, 1981, p 289.

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[Article by V. A. Vinokurov and B. S. Mitin: "Technology and Science"]

[Text] The increase of the role of technology in the life of society is a characteristic trait of the 20th century. It is explained by the sharp acceleration of the development of technology as a consequence of the systematic transformation of the achievements of the basic sciences into new technical devices and technological processes. The results of modern science have led to profound changes in the sphere of production, to the use of fundamentally new materials and fundamentally new methods of their processing, to the new organization of the control of production processes and a new system of designing and information processing. The changes in equipment and the organization of production are so great and are occurring so quickly that the term "technological revolution" is being used for them.[1] During the technological revolution over the decades new sectors of industry have been disappearing and emerging, profound changes have been occurring in the nature of labor, consumption and communication.

The urgency and fundamental importance for the fate of mankind of the problems, to which the latest technologies give rise, were discussed extensively at the All-Union Conference "The Social and Methodological Problems of Scientific and Technical Progress." In the September issue of the journal the discussion of these problems, which is based on the materials of the conference, commenced with the article of N. N. Moiseyev and I. T. Frolov.[2] This article is devoted to one of these problems--the interaction of science and technology.

In his report at the June (1983) CPSU Central Committee Plenum, "Urgent Problems of the Ideological and Mass Political Work of the Party," K. U. Chernenko advanced as one of the basic demands on research in the area of the social sciences the following: "...scientists need to act with a great orientation toward the future, to 'detect' in good time the imminent trends. I have in mind reliable forecasting, which would make it possible to see tomorrow better, to make sound decisions."[3]

Thus, the study on the basis of the methodology of Marxism of the nature of the development of modern technology, the aggregate of occurring technological

changes, their causes and possible consequences, the interaction of technology and science at the present stage, the interaction of technological and social structures is an important task which faces Soviet scientists. Mature socialism, which organizes the management of society on the basis of the scientific analysis of the laws of social development, requires the creative use of Marxist-Leninist doctrine. Basing himself on the acceleration of the processes of social development, Academician T. I. Oyzerman noted the increase of the role of philosophical research: "...the philosophical questions of the most remote causes and the most remote consequences of occurring processes, questions, which for a long time seemed alien to the methodology of science and the needs of practice, have found the most urgent, we could say, imperative [4](and, besides, not only theoretical, but also practical) importance."

Technology in its modern understanding is the methodology of modern production and includes the set of rules, skills and processes of production. By this term there are understood the mode, the system of physical production, the methods of obtaining and processing of various materials, and, on the other hand, the scientific discipline, which includes a collection of the knowledge and rules on the synthesis of technological processes, is designated by this term. Technology as a collection of the rules and skills of the production of specific material products has existed since the moment that man became a social being, and since ancient times has been an important factor of the progress of society.

In his analysis of social processes K. Marx regarded technology as an important factor which has an influence on the social structure of society, its culture and ideological ideas. In the first volume of "Capital" he wrote: "Technology reveals the active attitude of man toward nature, the immediate process of the production of his life, and as the same time of his social conditions of life and spiritual notions which spring from them."[5] Thus, changes of technology, changes of the nature of physical production can give rise to extensive social changes. However, the technological progress of society is only a necessary condition of its overall progress, and the possibilities of technological progress are realized only in the process of the development of the social system. The interaction of technology and the social structure is a dialectical process. The experience of history shows that the development of technology was not always a strictly progressive process. In the history of countries and peoples there were periods of the decline of technology owing to a conservative social structure, wars or natural disasters.

The progressive transformation of the social structure of society also gives a mighty impetus to the development of the technological base. Under socialism new sectors of industry and new fields of science and technology are being consciously developed on the basis of scientific planning. The emergence in our country of heavy industry, the rapid development of the organizational and material infrastructure of scientific and engineering activity and the development of a fundamentally new, all-encompassing system of education with the in-depth study of mathematics and the natural and technical sciences enabled our country in the technological level to achieve the leading world levels. The developed industrial base became the material basis of the

victory of our country in the Great Patriotic War, which had a most profound influence on the fates of the people of Europe and all mankind. Thus, science, technology and the social structure constitute a complex system with numerous interconnections and with a mediated nature of interaction.

The technologies of the manufacture of stone, bronze and iron tools of labor were successive steps of the development of society, which were connected, as a rule, with the corresponding social system. The improvement of technology made it possible each time to decrease the number of people, who were directly engaged in the sphere of physical production, and accordingly to expand the nonproduction spheres: management, education and others. The connection of the technological and social factors of development appeared most vividly during the first industrial revolution. The role of the emergence of machines and mechanized production in the development of capitalism was emphasized by F. Engels in his work "The Condition of the Working Class in England" in the following manner: "The history of the working class in England begins in the second half of the 18th century, with the invention of the steam engine and the machine for ginning cotton. These inventions served, as is known, as a stimulus of the industrial revolution--a revolution which at the same time produced a thorough upheaval in civilian society and the world historical importance of which they are beginning to understand only in recent times."[6] Precisely since the age of the first industrial revolution the process of the development of new technologies has been acquiring a conscious scientific nature and the rate of technological development has accordingly been speeding up. The development of technology "to order" led to the unification of technology with the natural sciences, and the surge of technology gave rise to the development of scientific research, and, on the contrary, the rise in the technological level of production, on the one hand, afforded new technical opportunities for the scientific experiment and, on the other, posed for naturalists problems of a qualitatively new level. Thus, although technology as a collection of the rules, skills and secrets of production has existed since the moment of the emergence of human society, technology as a science formed at the same time as the birth of the industrial mode of production.

In spite of the rapid rate of development of technology in the middle of the 20th century, technology as a whole is one of the most inert units of the social system, which is connected with the gradual nature of its development. Each new technological level in case of its development rests on a quite high preceding technological level, so that abrupt leaps are possible only in case of the influence of factors external to the given system. At the same time the borrowing of technology and the system of production from the age of the industrial revolution became one of the basic factors of the acceleration of social processes of the 19th and 20th centuries. The gradual nature of technological development is also conveyed by the principle "technology gives rise to technology," in the sense that every technological process requires for its support some new technological process. For example, the production of fabrics on looms requires the production of looms, the production of looms requires machine tools for the production of the machines themselves and so on. Thus, the technological processes, which exist at the given moment in society, are interconnected and interdependent, determining as a whole the technological level of society.

The reproduction by an artificial means of the processes existing in nature, the results of which had already been utilized by man, was the traditional means of the development of technology. Here the tools of labor reproduced the actions previously executed by the hands of man. The work of the loom, the forging press and the cotton gin was a direct analogue of the work of human hands. However, the modern fields of technology--nuclear, electronic, laser and biological engineering--characterize the use of materials and processes of their manufacture, which are not encountered in nature. This fundamentally new feature is characteristic of the technologies, which have arisen on the basis of scientific discoveries by their deliberate transformation into technical devices. The conversion of scientific knowledge into technology is becoming the basic factor of scientific and technical progress, and together with the improvement and expansion of scientific research the development of a scientifically organized system of the conversion of scientific achievements into real technology of society is becoming a key factor of the dynamics of economic and social progress.

Modern Technology Is a Product of Modern Science

The change of the nature of the reproduction of technology and its conversion into a product of modern science require the close analysis of the mechanisms of the interaction of science and technology and the possible consequences of such interaction for the economic and social structure.

However, before speaking about the basic consequences of the present technological revolution, let us examine in more detail the basic directions of its development and typical examples of its realization. The first distinctive trait of modern industry is the use of fundamentally new materials. Among them are plastics with a wide range of properties, new metals, such as titanium, aluminum and their alloys, synthetic crystals, ceramics and composite materials. The use of new nonmechanical technological processes, such as the laser and plasma treatment of materials, is the second fundamentally new direction. New power engineering, which is based on nuclear reactors, in many ways ensured the expansion of industrial production and its penetration into new regions. In a number of developed countries nuclear electric power plants are already providing a significant portion of all the generated electric power of the country, for example, in France about 40 percent.[7] Computerization, the extensive dissemination of computers and microprocessors in production, management and service is the newest direction of development. Computerization is introducing new principles of organization in all spheres of human activity, is giving a new impetus to the automation of production and is changing the nature of labor. Biotechnology, which is emerging under our very eyes, on the basis of the achievements of modern biology and genetic engineering has organized the commercial production of medicinals of a new level, such as human interferon and insulin, new synthetic food products and chemical sources of energy and in the future promises the direct conversion of solar energy into electric power with a high efficiency on the basis of the artificial reproduction of photosynthesis, unites a number of merits.

In the listed new directions of technology the link with the scientific disciplines, which gave rise to them, and with specific discoveries of

chemistry, physics and biology are obviously visible. However, the embodiment of scientific knowledge in a real production process is not a simple application, but requires serious intermediate technological research, additional scientific ideas and developments. As an example let us examine the technology of producing a nozzle for a rocket engine.

During the operation of a rocket engine the temperature of the gases of the rocket exhaust, which is exhausted from the nozzle at a high speed, comes to 3,000°. The material of the wall of such a nozzle should retain sufficient strength. For all existing thermally stable materials the retention of adequate resistance to heat and mechanical failure is possible only in case of the maintenance of the temperature of the walls of the nozzle at a sufficiently low temperature, that is, in case of an effective cooling system. Cooling for the retention of strength properties is required here precisely for the inside of the nozzle, which is exposed to the effect of the red hot gas jet. It proved to be impossible to find an alloy which has the necessary set of properties in pure form. The problem was solved by means of a new technological method--power metallurgy, namely by the development of the composite material tungsten-copper, in which the tungsten ensures the strength, while the vaporized copper ensures the cooling of the item. Thus, not only a thorough knowledge of the physical chemical properties of metals, but also a sufficiently serious scientific technological study of the problem were required when developing the technology of producing the new material.

The history of one of the greatest inventions of the 20th century--the history of the development of the transistor--is an example of when new scientific directions and programs have been formulated with an orientation toward the development of new devices and new technologies. As is known, the first transistor was developed in 1947 by John Bardeen and Walter Brattain at the laboratory of Bell Telephone. The studies of the properties of semiconductors had been conducted in this laboratory by a group of specialists headed by William Shockley since 1946. By that time semiconductor diodes were already being used extensively in electronics. The research group set as its goal to investigate as thoroughly as possible the phenomena of semiconductance and to explain them on the basis of atomic theory. However, as Bardeen noted in his Nobel lecture, the thirst to develop a triode, or semiconductor amplifier, was the basic justification of the development of research in this direction. Thus, the basic physics research, which was crowned by the 1956 Nobel Prize, in this case can be regarded as an example of the goal-oriented scientific development of a new type of technology--semiconductor technology, and this example is characteristic of key inventions of the present.

The orientation of scientific research, including basic research, toward the development of technologies and instruments is one of the manifestations of the process of the conversion of science into a productive force. In the chain of interaction "science--technology--equipment--production" the central active link, which guarantees the dynamics of development, is shifting more and more in the direction of science. Here the nature of science and its status in society are also changing in principle. The high value of technological knowledge and improvements for the obtaining of advantages in the competitive struggle already during the past century led to the observance of secrecy in the area of new industrial works and to dramatic stories of the

theft of production secrets and inventions. The remoteness of science from technology in the 19th century enabled science to retain an open nature without restrictions on the dissemination of scientific information. The link of science and technology in the 20th century led to the increase of the real practical value of scientific knowledge and to the substantial restriction of its free transfer. Thus, the restrictions of secrecy, which are characteristic of technology, also became a part of scientific life.

The present trend toward the shift of the active factor of interaction in the chain "science--technology--equipment--production" at the meeting point of science and technology has its causes in the nature of the scientific and technical revolution. In contrast to the technologies of the 19th century, which were based on intuitively transparent mechanical effects, the use of more and more subtle and unobvious natural laws, which have been discovered by the basic sciences, is characteristic of the technologies of the 20th century. Basic scientific discoveries at present require the close attention of technologists, since a delay with their introduction can lead to a catastrophic lag of technology behind the world level. The discoveries of semiconductor physics and solid-state physics, as a result of which the transition from the vacuum tube to the transistor and integrated circuit occurred, are an example of basic physics discoveries, which changed in principle and in a relatively short time the character of technology. Under the conditions of capitalism this transition was accompanied by the disappearance of firms which had not been able to take up new technologies in good time, in particular, firms, which previously produced vacuum tubes, are absent today in the list of the largest firms which produce integrated circuits in the United States.[8]

The need to constantly keep track of, and at best to foresee scientific discoveries leads to the increase of the proportion of scientific research and experimental design developments in the cost of new technologies and the final product being produced. In this connection the term "science-intensive products" has become widespread with respect to items of the most advanced sectors of industry, such as the electronics and aerospace sectors. In recent decades production in the science-intensive sectors has been increasing rapidly and has constantly been increasing its proportion in the total volume of industrial production of the developed countries. The fast pace of the development of production and the fast obsolescence of products are having the result that in contrast to the traditional sectors of industry in the science-intensive sectors the gap between the level of scientific research and experimental design work and the technology being introduced is disappearing, that is, nearly all the results of scientific and design development are being introduced in real time.[9] Thus, a permanent "science--production" conveyor, which converts scientific achievements into new technologies and new devices, is forming. Thus, in the newest science-intensive sectors we see the most vivid embodiment of the thesis of the conversion of science into a productive force, when scientific research stands at the beginning of the permanent chain which forms production.

The computerization[10] and automation of production and designing are now the most important factor which are causing the acceleration of the interchange of technologies and equipment. The interaction between the shortening of the

cycle of the obsolescence of technologies and machines and the computerization of production is characterized by positive feedback, that is, on the one hand, the rapid updating of equipment requires the automation and the placement on an industrial basis of the very cycle of the development of new technologies and machines, but, on the other hand, automation is the tool which makes possible the fundamental acceleration of the transfer of scientific achievements to production. Computerization and the fast pace of the scientific and technical revolution have placed on the agenda a fundamentally new question: not simply the automation of production, but the automation of the process of transferring scientific knowledge into production and the automation of the very process of obtaining new knowledge. Precisely in recent decades we have been observing the rapid development of computer-aided design systems (SAPR's) and systems of the automation of scientific research (ASNI's) on the basis of computerization. Thus, a machine, which transfers scientific knowledge into production with the minimum involvement of man, is taking shape. A significant portion of the scientific and technical potential of the developed countries is now being spent on the formation of such a machine, such an intermediary link of "science--production," since the technology of production of the future is taking shape precisely here, its versatility and capacity for constant development are determined here.

The dialectical nature of the development of modern technology finds expression in the fact that today the main task consists not in the maintenance of technology at the achieved high level, but in the need to change it constantly and promptly. Here the most significant changes occur not in the direction of modernization, but by the fundamental transformation of technology. Automatic machines now make it possible without the involvement of man to maintain production in a stationary state in the most complex technological processes, but the process of the interchange of the items being produced and the technology of their production still requires the significant involvement of man and often significant expenditures of time. However, the possibilities of computers, which assume a number of components of intellectual labor, are now being realized in versatile automated production systems (GAP's), which are already operating and are still being designed and in which the changeover to the production of a new type of product reduces to the change of the program in the control computer. The computer today has made it possible to form a chain of the automatic transfer of new knowledge into production through systems of the automation of scientific research, computer-aided design systems and versatile automated production systems, that is, a system, which automatically keeps track of the latest achievements of science and shapes the technology of production, in which the involvement of man to a significant degree is mediated, has been developed.

Social Aspects

The above-described processes and trends raise the question of the change of the role of man in production, of the social consequences of automation and the philosophical interpretation of its consequences. The processes of automation, which are now being observed, are a new stage of the constant process of separating man from the object of labor, which is occurring owing to the development of the means of production and social relations. Whereas

the first industrial revolution transferred to machines the immediate tools of action on the object of labor from the hands of man, having left to man the control of the machine itself, the technological revolution of today is freeing man from the constant control and monitoring of machines and, moreover, to a significant extent also from the designing and development of these machines, raising the production activity of man to a scientific activity. The current technological revolution is humanizing productive labor, transferring the basic content of the labor activity of man to the area of scientific research and development.

Computerization, being one of the basic driving factors of the technological revolution, is producing profound changes in the nature of labor and is leading to the decrease of direct physical labor and its replacement with the labor of the programmer and operator. Here a characteristic feature of labor in computerized systems is its intellectual nature, that is, the activity of man in such systems consists in work with information, the development of programs and the analysis of versions, and not in direct physical action on the object of labor. Computerization created a new basis for the formation of a unified nature of labor in various areas of industry, management and service. Now the producer of metal-cutting machine tools, fabrics or knitwear, rolled metal products, integrated circuits, chemical fertilizers or plastics has the opportunity to form a complete description of his technological process in the form of a computer program and to record it on magnetic tapes or other compact storage devices. Here the standardization of production and the development of versatile automated systems are making it possible, by transferring the corresponding program or set of programs, also to translate the corresponding technology. The time spent on the process of transferring technology is reduced to a minimum and the value of the very development of the technology, and particularly its recording in the form of information on a physical storage device, accordingly increases. Thus, new computer technology once again confirms the verity of the conclusion of K. Marx that the process of production in its development is transformed more and more into the use of the labor accumulated in science, and not only the direct labor of the worker: "...the entire process of production appears not as a process which is subordinate to the immediate skill of the worker, but as the technological application of science."[11]

Thus, whereas the first industrial revolution created a unified form of the labor of the industrial worker, the current technological revolution is creating a unified form of labor in the form of the labor of the programmer, while the initial forms of the labor of the metallurgist, the bank official, the operator of a chemical reaction vessel, the mechanic and so on in external manifestation had little in common.

The existence of systems, which convert information into productive labor without the direct involvement of man, characterize the basic feature of the current technological revolution. Whereas the replacement of the physical labor of man with the labor of a machine and in the future with the labor of a mechanized automatic machine was characteristic of the first industrial revolution, the replacement of the reproductive components of mental labor with the labor of computers is characteristic of the current technological revolution. The terms "mechanization" and "automation" arose during the age

of power-driven machines and devices, while the components of intellectual labor are being reproduced today by electronic machines and, in the future, perhaps, by devices on an optical or biological basis. Therefore we suggest the term "the computerization of metal labor" as the one most equal to the essence of the process.

The computer revolution gave rise to a new type of technology--information technology. A new, rapidly developing sector of the economy, which engages in the gathering, storage, processing and dissemination of information, emerged. Included in it are: satellite communications systems of a state and international scale; television and radio systems; teletext systems; trade credit computer systems; automated systems for the gathering of defense and economic information; data banks of individual organizations and so on. The sectors of industry, which provide the data processing industry with equipment, are developing at a leading rate as compared with traditional sectors. Information science as a field of technology and economics has become such an important factor, which influences the dynamism of social development, that in the state plans of development of France, for example, its priority development is envisaged, which, in the opinion of experts, will lead to the corresponding development of electronics and related science-intensive sectors. The possession of the necessary information and the possibility of its adequate processing are now becoming a more and more important characteristic of society. Incidentally, the problems of the development of information technology and its philosophical and social interpretation are covered in the works of G. S. Pospelov,[12] V. A. Zvegintsev,[13] and a number of other Soviet and foreign authors.[14]

Systems of the computer-aided designing of new items are now operating successfully in many fields of electronics, the aerospace and automotive industry, but the processes of the development of new technologies lend themselves to a significantly smaller degree to automation. Such processes contain essential creative features, which in most cases lend themselves poorly to formalization. As a result of the key importance of technology for the formation of the level of production and the poor level of the automation of the process of developing new technologies technological innovations are today one of the most guarded and costly objects of trade.

Experts of the developed countries in the area of trade are advancing the concept that at present trade in technologies, and not trade in goods and individual patents, is the most profitable sphere of foreign trade. The corresponding recommendations are already finding reflection in the trade policy of such countries as Japan. The trend toward the leading development of trade in technology as compared with trade in finished items and toward the leading increase of the production of and trade in science-intensive products attests that scientific knowledge, which has been accumulated in various forms, constitutes a larger and larger portion of the goods and services being sold on the world market. The buyer pays here not only for the expenditures on production itself, but also for the capital investments, which were made at the stage of scientific research and of scientific research and experimental design work. The great development of basic and applied scientific research is a condition of the competitive ability of the products being produced in the given country, while, on the other hand, the countries, which have

developed science with its successful introduction, carry out its financing at the expense of the buyer. The mechanism of positive feedback in the development of one's own science is thereby formed. The stimulating effect of the capital investments made in science on the growth rate of industrial production and labor productivity is a fact which is noted by foreign researchers, for example, in materials of the United States of America.[15]

Science, in becoming the leading unit of economic development, requires more serious attention to its planning and financing, to the organization of its interaction with production and to the forms of the connection of scientific research and technological development. The general trend is the direct dependence of the increase of labor productivity and the level of production on the amount of the share of the national product which is spent on science. However, a significant difference by countries of the world exists in the forms of the financing of and the distribution of assets between basic and applied research and introduction. On this level the strategy of Japan, which in the 1950's and 1960's placed the main emphasis on applied research and development, bringing the licenses and patents purchased abroad up to a higher level than that of the original source, is very interesting. After Japan became in the 1970's the leader of the capitalist world in a number of science-intensive sectors of industry, a redistribution of the assets being allocated for scientific research in the direction of the increase of the allocations for basic research occurred. The relative decrease of the importation of licenses and patents and the expansion of the export of patents and technology became an external indication of the change of the strategy of Japan in the area of science. At the same time both the highest percentage of the national income spent on science and the relatively stable distribution of assets between basic and applied research and introduction are characteristic of the United States, which retains the position of the leader of the capitalist world in the area of technology.[16]

At present, as N. A. Tikhonov noted, "...the acceleration of scientific and technical progress is the leading unit of the economic strategy of the CEMA countries for the foreseeable future."[17] The basis of scientific and technical progress is the fast development of science and the rapid introduction of its achievements in technology and production. Thus, the elaboration of the strategy of the development of science and its interaction with technology and production is becoming a key factor of the overall strategy of development in our country and the socialist countries. The elaboration of the strategy of the joint development of science, technology, equipment and production, which includes the planning of the distribution of material, manpower and financial resources; the determination of the optimum organizational forms of cooperation and management; the formation of a system of stimulation and control and so on, requires the thorough philosophical analysis of the role of these factors in social development and the features of their interaction. Here it is impossible to understand the essence of the problem while remaining within the framework of purely economic examinations, since the role of science and the stimuli of its development are revealed not only by economic categories, a sociophilosophical, systems study is required.[18] Thus, for the solution of the problems of scientific, technical and economic development we come again to the need for a philosophical analysis of the concepts "science," "technology," "equipment" and "production"

in their interaction and mutual influence. Moreover, the optimization of the strategy of social development at each stage requires the examination of the ratio of basic and applied science and introduction or the combination of various types of technology and their adequacy for the goals of society. For example, from the point of view of the global problems of mankind biotechnology is singled out as the one which corresponds most to the solution of the problems connected with the biological flourishing of man.[19]

The shift of the active center in the system "science--technology--equipment--production" to the meeting point of science and technology is becoming an important function of science, namely the unit with converts scientific knowledge into technology, and requires particular attention. In our country with a universally recognized high world level of basic research in recent years precisely the problem of the utilization of basic scientific achievements in technology and equipment has been attracting the attention of the party and government. Soviet scientists are working on the problems of the development of technology in its various aspects, and these questions are at the center of attention of the basic organizing unit of our science--the USSR Academy of Sciences. A number of statements of leading Soviet scientists have been directly devoted to the tasks of the development of technology--for example, the statement of Academician Yu. A. Ovchinnikov[20] on the development of biotechnology, of Academician A. A. Samarskiy[21] on the use of mathematical methods in the tasks of technology and others. The USSR Academy of Sciences is promptly creating new scientific collectives in the more important directions of scientific and technical progress, particularly for the development of computer technology, which is now one of the key factors of scientific and technical progress. The new information science and computer technology department and a number of new academic institutes for the development of the technology of the production of computers of a new generation (see the statement of Vice President of the USSR Academy of Sciences Ye. P. Velikhov)[22] have been set up by the Academy of Sciences. Thus, Soviet science is actively assuming not only the generation of new knowledge, but also the production on this basis of new technologies, up to the organization of the series production of new equipment, which conforms to the changing role of science in society.

For the current development of society the interaction of science and production through technology is playing a central role, therefore the organizational forms of this interaction, which directly influence the intensity of the process of embodying knowledge in technology, require a constant search and development. The basic goal of the organizational changes at the scientific institutes and higher educational institutions of the country is the shortening of the organizational and temporal transfer link of "science--production." It is characteristic here that the greatest gains in the development of advanced technologies are achieved when combined organizational forms, which are specially aimed at the formation of the transfer mechanism of "science--production," are developed. This is evident from the examples of both production associations--the work of the Tallinn RET Association,[23] and the science of higher educational institutions--the work of the Tomsk association of higher educational institutions,[24] as well as academic institutions--the work of the Belorussian academic scientific and technical complexes.[25] It seems that the study of the role of various forms

of scientific research in the dynamics of economic and social development and the more perceptive penetration of the mechanisms of the generation of new knowledge and the processes of their transfer into the technology of society are the basis for the comprehensive planning of the scientific and technical progress of socialist society.

The questions of the planning of scientific and technical progress at present have acquired extreme urgency owing to a number of factors, the main one of which is the overall acceleration of the development of society. The radical changes in the structure of production, which are being produced by the latest technological discoveries, are occurring in such a short time that their corresponding social consequences cannot always be comprehended in good time. Fundamentally new technologies, the changeover to which requires the radical transformation of production and significant material expenditures, cause, as a rule, the greatest consequences. A classical example of new technology, which has changed substantially the nature of labor, is the introduction of microprocessors in the watch industry, when the equipment, the methods of acting on materials and the possibilities of the item being produced have changed completely. The Swiss watch industry, given the sudden onslaught of microprocessors, lost about 46,000 workplaces and switched in many ways to the production of jewelry. The fast speed of the economic, social and physical consequences of the introduction of new technologies is becoming a serious factor, which is attracting the attention of both individual scientists and government and international organizations. In world scientific literature the term "technology assessment,"[26] which can be translated as a "tax," "fee" or "fine" for technology, has become widespread. The example with atomic technology, the military uses of which now threaten the existence of mankind, had a significant influence on social consciousness and called into question the progressiveness of the introduction of scientific discoveries. Given the development of genetic engineering the consequences of its possible technological use aroused in the scientific community of the United States such suspicion that for some time U.S. scientists introduced a moratorium in this sphere of research. The ambiguity of the results of technological innovations and the existence of unexpected negative consequences are increasing the attention of scientists and state organs to the forecasting of technology. A special technology assessment committee,[27] one of the basic functions of which is the assessment of the social consequences of the introduction of new technologies, has been set up in the U.S. Federal Government. The fundamental value of forecasting consists in the fact that a correct forecast is a source of material and social benefits, an erroneous forecast can lead to the destruction of economic and social structures.

The forecasting of technologies is possible on the basis of the cause-effect and time dependence of technology on applied and basic scientific research. The analysis of the current achievements of science is the main buttress of the foreseeing of the future development of technology. However, the consequences and forms of the use of new technologies are determined not only by the existing level of science and equipment, but also by the social system of society. Whether the possibilities of new scientific discoveries will be used for the good of society or against the majority of its members, will depend precisely on social factors.

FOOTNOTES

1. In domestic literature this term was used, in particular, in the articles: F. M. Burlatskiy, "The Technological Revolution and the Ethics of Robots," LITERATURNAYA GAZETA, 31 October 1984; R. Yanovskiy, "Socialism, Science, Man," PRAVDA, 28 September 1984.

2. N. N. Moiseyev, I. T. Frolov, "Great Contact. Society, Man and Nature in the Age of Microelectronics, Information Science and Biotechnology," VOPROSY FILOSOFII, No 9, 1984, pp 24-41.

3. "Materialy Plenuma Tsentral'nogo Komiteta KPSS, 14-15 iyunya 1983 g." [Materials of the CPSU Central Committee Plenum, 14-15 June 1983], Moscow, 1983, p 34.

4. T. I. Oyzerman, "The International Forum of Philosophers: The Philosophical Dispute," VOPROSY FILOSOFII, No 5, 1984, p 31.

5. K. Marx and F. Engels, "Soch." [Works], Vol 23, p 383.

6. K. Marx and F. Engels, "Soch.," Vol 2, p 243.

7. S. Zaleski, "Nuclear Power in Today's World--Paradise Lost, Hell or Purgatory?", ATOMNAYA TEKHNIKA ZA RUBEZHOM, No 2, 1984, p 30.

8. A. A. Kuteynikov, "Competition on the Markets of New Science-Intensive Goods," SSHA--EKONOMIKA, POLITIKA, IDEOLOGIYA, No 8, 1984, p 98.

9. Ibid., pp 90-91.

10. For more detail on the technological and social consequences of computerization see: Ye. B. Armenskiy, V. A. Vinokurov, P. S. Dyshlevyy, "The Interaction of Mathematics and Technology Through Computers Under the Conditions of the Scientific and Technical Revolution," VOPROSY FILOSOFII, No 11, 1983.

11. K. Marx and F. Engels, "Soch.," Vol 42, Part II, p 206.

12. G. S. Pospelov, "Artificial Intelligence. The New Information Technology," VESTNIK AN SSSR, No 8, 1983.

13. V. A. Zveginstev, "Artificial Intelligence and Linguistics," VOPROSY FILOSOFII, No 11, 1983.

14. See, for example, VOPROSY FILOSOFII, Nos 2, 3, 4, 1979.

15. J. H. Holloman, "Technology in the United States: The Options Before Us in 'Technology.' A Reign of Benevolence and Destructions," M M S Information Corporation, New York, 1973.

16. Ibid.

17. N. Tikhonov, "The Basis of the Strengthening of the Cooperation of the CEMA Countries," KOMMUNIST, No 10, 1984, p 9.

18. V. Zh. Kelle, "The Correlation of Determinism and Systemicity in the Methodology of Social Cognition," VOPROSY FILOSOFII, No 6, 1983.

19. See I. T. Frolov, "Man and Mankind Under the Conditions of Global Problems," VOPROSY FILOSOFII, No 9, 1981.

20. Yu. A. Ovchinnikov, "Biotechnology and Its Place in Scientific and Technical Progress," VESTNIK AN SSSR, No 4, 1982.

21. A. A. Samarskiy, "The Computation Experiment in the Tasks of Technology," VESTNIK AN SSSR, No 3, 1984.

22. Ye. P. Velikhov, "The Achievements of the Physical Technical Sciences and the Tasks of Scientific and Technical Progress in the National Economy," VESTNIK AN SSSR, No 5, 1984.

23. Ye. Temchin, "But Was There a Miracle?", LITERATURNAYA GAZETA, 8 August 1984.

24. F. Peregudov, "Higher Educational Institutions Have Become 'Shareholders.' Efficient Use for the Scientific Potential," PRAVDA, 15 August 1984.

25. V. Ye. Kudashov, Ye. S. Kukolko, "The Organization of the Planning of Operations at the Academic Scientific and Technical Complex," VESTNIK AN SSSR, No 6, 1984.

26. "Technology Assessment. Understanding the Consequences of Technology Applications," Braeger Publishers, New York, 1972; "Technology Assessment for Development. Report of the United Nations Seminar of Technology Assessment for Development," United Nations, New York, 1979.

27. S. M. Zagladina, "The Organization of the Forecasting of Scientific and Technical Progress," SSHA--EKONOMIKA, POLITIKA, IDEOLOGIYA, No 7, 1984, p 98.

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GENERAL

POLITICAL ECONOMIC ANALYSIS OF TECHNICAL PROGRESS

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 3, Mar 85 pp 81-92

[Article by P. Ignatovskiy: "Technical Progress and Socialist Production: A Political Economic Analysis"]

[Text] In the theoretical and political substantiation of the tasks of the development of the economy the CPSU bases itself on the analysis of actual reality, its complex, contradictory processes and ripe long-range problems.

In the article of Comrade K. U. Chernenko "To the Level of the Requirements of Mature Socialism" attention is directed to the fact that associations and enterprises, which are furnished with advanced equipment and technology and are characterized by efficient organization, high labor productivity and production efficiency, are determining more and more the present character of our economy. As a whole they are at the level of the requirements of mature socialism. "These are real shoots of the future, which should multiple and grow stronger together with the development of the scientific and technical revolution and science-production and agroindustrial integration, with the dissemination of advanced know-how throughout the system of the national economy.

"At the same time we have quite a number of enterprises, which are operating on already obsolete equipment and with the use of technologies of yesterday, and there are also such enterprises, at which manual, unskilled labor, in which, as is known, millions of people are still engaged in our country, predominates. And this means that here the material, technical and organizational aspects of production are, using the language of dialectics, at a definite variance with its socialist socioeconomic nature, which stems from public ownership.

"This is a real contradiction of the period we are living through. To resolve it means to 'pull up' the lagging sections to the level of the leading ones, decisive change in the matter of the intensification of all its sectors."[1]

The solution of these problems receives concentrated expression in the intensification of production, of which, in turn, scientific and technical progress is the basis.

Today it is already insufficient to imagine the content of intensification only as the more complete utilization of the operating productive capital during the age of the increasing processes of the scientific and technical revolution, with its radical changes in the technologies of obtaining man-made materials and natural materials and extracting them. The productive capital--machines and equipment--is becoming worn out and obsolete more and more rapidly, the technological processes, which entail specific expenditures of raw materials, materials, fuel and electric power, which have ceased to be socially necessary, and therefore have already become inefficient for society, are becoming obsolete. Their more "complete" utilization at its heart means the increase of the inefficiency of national labor, which is at variance with the essence of the intensification of production, the increase of labor productivity and the saving of material and manpower resources.

But precisely these goals constitute the economic content of scientific and technical progress and are accomplished by it. Not equipment in itself, not the components of what is new in technology and the organization of labor, that is, not the set of some, though even most necessary, organizational and technical measures, but the real saving, which increases productivity and is expressed in the increase of material wealth, especially DUE TO ECONOMY [in boldface]--in this lie the original source and result of the technical improvement of production.

And if one approaches technical progress with such a yardstick, the drawn out discussions on the increase of the interest in technical progress and on the advantage or disadvantage of the updating of production appear in a quite different light. For there logically arise the questions: To whom, strictly speaking, is it disadvantageous? And what is disadvantageous? The saving? Is not such an interpretation of "advantage" from the standpoint of the interests of society, the collective and each worker unnatural? For to whom is it advantageous, for example, when under the conditions of an industrial complex not more than 5 tons of mixed fodders are consumed per ton of pork, while at a number of kolkhozes more than 8 tons are consumed? Such a question also applies to the weight of machine tools, the thickness of pipe, the consumption of fuel, cement and so forth. There is obvious here the confusion in the interpretation of social values, which became possible as a consequence of the still inadequate elaboration of the methodological aspects of the problems of scientific and technical progress, its underestimation as a means of the saving of resources, the achievement of the genuine intensification of production, the overcoming of elements of technical stagnation, the lag of the standard base and other phenomena, due to which the expenditures, which have already ceased to be socially necessary, are being preserved in the practice of management as legitimate and "advantageous," technical progress is becoming the topic of discussion in the sense of an interest in it, while in the activity of individual enterprises it frequently reduces to individual measures which are not interconnected.

Such an approach merely aggravates the contradictions of our economy, affects the conditions of the realization of its advantages and is not conducive to the increase of the conformity of the practice of management to the socialist socioeconomic nature.

The efficiency and effectiveness of the noted conformity appear in responsibility to society--the responsibility of the collective of the association (enterprise) and the sector for the meeting of a specific need, for the sake of which it allotted the collective the necessary production capacities and other factors of production in order to use them efficiently for the production of the items needed by society--the products of labor. Precisely products, and not the sum of the values. But, as is known, in the activity of individual enterprises a bias in the direction of the magnitude of the value is allowed, which is a reflection of the contradiction between the use value and the value of a commodity as the consequence of the dual nature of the labor embodied in it. This contradiction increases in case of a deviation from the interests of socialist society, and first of all in case of the underestimation of scientific and technical progress and the interpretation of its "disadvantageousness."

Under the conditions of a contradiction between the use value and the value and the preference by individual producers of the value to the detriment of the interests of society, which is interested in a specific product and its quality, it is difficult to solve the problem of the development of scientific and technical progress by prices and other value means. Meanwhile for some time the opinion has begun to take root that it is sufficient to use price reductions for obsolete products and technical progress will receive the necessary impetus for its development. It should be noted that price reductions of this sort are envisaged by standardized documents, but they are not always used and do not yield the desired results. This is not accidental. The contradictory influence of value on the economic relations of socialism is noticeable in the very fact that the use of price reductions for obsolete products also turns into a problem. It deforms interest: society and the collective of the enterprise as its component are interested not in the increase of the value, but in the increase of the mass of products with the saving of material and manpower resources, but the large amount of value, which is formed by means of prices, distorts the reflection by it of the material world of products, creates the notion of increased social wealth and therefore weakens the interest in the reduction of the prices for products, even though they are obsolete, since such a reduction creates the appearance of a decline of the rate of production. And even when price reductions for obsolete products are used, this is done administratively.

Such is the consequence of the contradictions, which are totally unavoidable under the conditions of the dual expression of labor--in the product and its value, but can be smoothed over. Since in the turnover of goods their "exchange value appeared to us as something entirely not dependent on their use values,"[2] owing to such independence the value, which appears in the form of the exchange value, objectively stimulates producers to increase it without the corresponding increase of the amount of use values.

Our practice of management is confronted with similar phenomena in case of the increase of wholesale prices, the increase of production costs and such distortions of the relations of the enterprise and society (the state) as upward distortions of the achieved results. For the real interest of socialist society consists in the increase of the mass of products of labor (use values), and not simply in the increase of the amount of value in the

form of the gross and commodity output or other forms of it. The roots of the difficulties in the commodity backing of the income of the working people, as well as the establishment of the uniform material and technical supply of production lie here.

Meanwhile the separation of the value from the use value, which became possible on the scale of social production, at times is used for the preservation of the traditional, but already obsolete methods of production, without technical updating. Given such an approach, technical progress proves to be "disadvantageous." Being embodied, for example, in advanced technology and providing a saving of material resources and living labor, it leads to the decrease of the value of the produced products, that is, to a "reduction" of the volumes of production in value terms, which at times proves to be unacceptable not only within the enterprise, but also at other levels of economic management.

This acute contradiction of our economic practice has not yet been completely overcome, therefore it is not at all by chance that the outlined measures in the area of scientific and technical progress did not yield the anticipated results, although the development of the basic sciences also affords for this favorable prospects, which, however, are coming up against the inaction of several sectorial scientific units and practice in the matter of introducing innovations. But such inaction is also not without reason.

Having achieved its apogee in the form of capital and already under its domination being undermined (according to the definition of V. I. Lenin) by the monopoly, value under the conditions of national ownership is coming more and more into conflict with the use value, objectively giving way to it in the system of interests of socialist society and, naturally, in the network of social contacts. But here, too, it has great inertia in the influence on the consciousness of people. While the products of labor circulate as goods, value traditionally squeezes out the use value in the consciousness of the supplier of masses of goods. Therefore the reorientation of the consciousness of the producer toward the use value, first of all toward the quality of the product of labor, is necessary in socialist society. The constant introduction in the consciousness of workers, especially production organizers, of ideas about the socially new economic function of the use value, which is based on the historical foresight of K. Marx concerning the unnatural nature of value forms as a means of checking the results of socialist production, is required, since it turns out: the greater the value is and, consequently, the more expensive the materials are, the more of them that are spent on the production of goods, the further they are hauled and the greater the transportation and other costs are, the better it ostensibly is in the end for society.

The capitalist is interested in a high price, but this interest is inseparable from the value and together with it "migrated" into the boundaries of the socialist enterprise--the producer of the product of labor. And when as a result of a number of reforms of production ties, which were not always supported by adequate political economic grounds, the value forms became dominant in the monitoring of production and in the evaluation of the activity of enterprises, it came to light even more that the increase of the volumes of

production in value terms was not always and not in every sector supported by the corresponding increase of the use values. Precisely this circumstance affected the meeting of the production needs of the national economy and personal needs for several types of consumer items. With respect to a number of sectors, particularly shoemaking and garment making, the rolling of metal and construction, the quality of the results of labor gradually fell behind the requirements of consumers.

The economic experience of the last 2 years of the five-year plan convinces us that the results of production presume the more effective monitoring on the part of the socialist state and all society of the consumption of resources, quality, the measure of labor and the measure of consumption, which is based first of all on the accounting of the products of labor and their deliveries.

The possibility of increasing the value magnitudes without the improvement of the equipment and production technology not only checks technical progress, but also drastically weakens all stimuli of it, including the mobilizing function of the plan. Primarily for this reason the changes in the technological improvement of production have not yet become universal and essential for the national economy as a whole and individual sectors, a sharp change in the increase of labor productivity, the saving of material resources and the increase of the economic efficiency of national labor has not been achieved.

Today's state of the technical level of production in a number of sectors and associations (enterprises) requires further steps, which are aimed at the systematic development of production, with allowance made for the needs of society, its interest in the increase of production efficiency and a larger amount of products from the raw materials being consumed.

Socialized production cannot be developed without further technical improvement, without the saving which follows from the very fact of the concentration of means of production and their mass use. This objective condition of the progress of production at present governs the practice of management at every enterprise, at every production, and especially scientific production association. Without changes in production technology, retooling and the organization of labor an appreciable increase of production, which is accompanied by an increase of labor productivity, becomes extremely difficult.

Unfortunately, production in many cases is faced with the underestimation of the achievements of science and technology, advanced know-how and the need to bring the enterprises, which have lagged technically, up to the level of the leading enterprises. This need follows from the laws of the socialization of production, to which K. Marx directed attention: "Even the constant improvements, which are possible and necessary here, originate entirely and exclusively from social experience and observations, which production, which is carried out by the aggregate worker, who is combined on a large scale, makes possible and gives."[3]

Social experience under the conditions of the lack of competition and the domination of the relations of the public ownership of the means of production objectively acquires extensive freedom for study, promotion and the

organization of introduction. But the entire set of these factors--from study to introduction--presumes an organizing basis. In other words, organization has been brought to the forefront in the improvement of production, in its scientific, technical and economic development. At the same time organization itself and the arsenal of its means also need improvement. And this problem is becoming the key to the solution of the problems of the technical improvement of production.

Under the conditions of socialist production relations with the all-encompassing function in them of systematicness the plan of the economic and social development of the country is playing a decisive organizing role in the economy and, of course, in the scientific and technical improvement of production. A specific plan of the scientific and technical development of the production of specific types of products, as well as the achievement of other goals, which are subordinate to the increase of labor productivity and production efficiency and the solution of social problems, should be elaborated in every sector.

There are being expressed in the press suggestions that the drafting of the plans of the development of science and technology, the assimilation of new types of products and the removal from production of obsolete ones, the introduction of advanced technology and the halt of the use of backward technological processes should precede the compiling of production plans. What are meant are not simply leading dates of the preparation of some sections of the plan as compared with others, but the increase of the influence of the plans of the scientific and technical improvement of enterprises on basic production--on the output of better quality and more economical machines, equipment and various items. The possibility of realizing this need is created by the formulation of long-range plans of scientific and technical progress, which needs organizational consolidation, careful study on the intersectorial level, the appropriate planning, resource supply and economic substantiation.

Frequently the incompleteness of the cycle of the preplanning preparation of measures of scientific and technical progress checks its planning and the subsequent implementation of the plans and their influence on current production. As a result of such omissions the aspiration to "incorporate" the outlined steps on technical progress in the practice of management, which is entirely subordinate to the fulfillment of the current plans, does not always yield results. The "internal" coordination of the plan itself and its sections is necessary. If in the section of scientific and technical progress individual measures, which do not determine the level of production, are planned, while in another section the output of the same obsolete products is planned, one ought not to count of the success of the steps on technical improvement. In such cases the sections on the planning of the technical updating of production prove to be appendices to the current plan assignments and do not contribute to the solution by the collective of the enterprise of technical, economic and social problems.

The difficulty is that the operations on the accomplishment of technical improvements at the enterprise are quite labor-consuming and require additional workers, whom the collective engaged in basic production does not

have. Therefore the technical improvement of production sections involves a great strain in the activity of enterprises and is not encountering proper support.

Meanwhile the prospects of the development of production under the conditions of the cumulative processes of the scientific and technical revolution presume the turning of the steps of technical improvement into a decisive factor of the implementation of the current production plans. Technical know-how quickly becomes obsolete. To detect these phenomena and to oppose new technical solutions to them--in this lies the essence of the management of production under present conditions.

But the difficulties of supporting the plans of current production and the availability of the least, still unused reserves of the increase of the products, which are becoming obsolete, as if preserve the achieved technical level and dispose the management of the enterprise to the retention of the operating technology and the range of items as long as possible, with the exception of individual minor innovations. The imperfection of the economic evaluations of the operation of enterprises also shows up here. Therefore socialist society and its state cannot but broaden their control and their influence on the technical level of production and the updating of its structure, technologies and, consequently, means of production.

Given the importance which the problems of product quality and the saving of resources are assuming today, the role of state standards as a gauge of the conformity of items and the methods of their production to the latest achievements of science and technology is increasing.

The state standard is objectively capable of playing a more active organizational function in the replacement of obsolete technologies and ranges of items with modern, advanced ones. And precisely the state can oppose the standard to the conservatism of the traditional methods of production and types of output being produced.

Items, which do not conform in their qualitative economic characteristics and methods of production (technologies) to the new standards, should not be included in the regular (annual, five-year) production plans. Thus, the state standard is becoming an organizational lever of the advance of the latest achievements of science and technology into production. It has the opportunity to strengthen in this direction the organizational, mobilizing function of the plan and to make up for the weakness of the price factor and other economic stimuli.

Along with the planning of the production of new products it is necessary to plan the transfer to the enterprise of the corresponding new technology. In this case technical updating will cease to serve as an appendix to basic production and will turn into a decisive factor of the fulfillment of the current production plans. Such reorganization of the plans of the organizational support of the technical development of production as a factor of its intensification and the increase of the efficiency of national labor has become quite imminent.

The essence of this problem is significantly broader than the simple conformity of one item or another or its technology to the standard. The state standard can perform only the role of a tool, which supports the plan and clears the way for it to influence the technical level of production. It reveals the lack of conformity of an item and the technology of its production to the present level, orienting the planning studies of the scientific and technical improvement of production toward the need for the updating of its structure. But the basic goal of the subordination of standardization to the planning of scientific and technical progress is not confined to the immediate function of standards--the achievement of conformity between the quality of items and the technical level of production. The main thing is that the entire national economy, first of all industry and especially machine building, would be adapted to the assimilation of scientific and technical innovations and their prompt, unimpeded spread to other sectors and associated and related works.

Structural measures, which are implemented by two means, are also required for this. One of them consists in the fundamental combination of sectorial scientific research institutes and design bureaus with enterprises within scientific production associations. This means has been tested in our national economy. Now the thoroughly weighed, systematically realized process of the further broadening of the network of scientific production associations not only within sectors, but also on an intersectorial basis is advisable, if this ensures the increase of the efficiency of their operation.

Proposals of this sort can be studied by the corresponding central departments, which stand over the sectors, and be submitted for the consideration of directive organs, on the basis of statewide interests.

The second means is the distinction in the sector of the head enterprises, which are called upon jointly with scientific subdivisions to develop and turn over to other enterprises new technologies, as well as to carry out the on-the-job training and advanced training of staffs of specialists and workers of mass occupations for the enterprises which operate in accordance with the new technologies.

The possibilities of scientific production associations as the most promising organizational form of the combination of science and production can increase the technologization of science and the dissemination of its achievements in the sphere of production, but precisely this is the most vulnerable link in the influence of science on production.

Scientific production associations eliminate the "gaps" in the "sectorial science--production" interconnection, which serves as a leader of the achievements of basic science into the national economy. The weaknesses of precisely this scientific unit check the advance of scientific discoveries and inventions into production.

Scientific production associations, which are well-off scientifically and competent in the sphere of production and the success of which in many ways will depend on resourceful management, which conforms to the needs of the national economy and is directed from a single scientific methods center which

places "orders" at scientific production associations, make it possible to solve this problem. The network of separate sectorial scientific research institutes, which organizationally are not connected with production and are not concerned with the tasks of the updating of the technologies of the production of specific types of products, can be limited. Here intersectorial scientific research institutes for the development and the engineering support of the updating of the technologies of the production of specific items will be needed. The setting for them of specific tasks on the updating of production goes beyond a single enterprise, but can "be completed" primarily at the "head" sector which concludes the technological chain of the production of the given item.

It is a matter of the weak spots of the organizational support of scientific and technical progress, which adversely affects the results of its planning, particularly the implementation of many goal programs, which given the current level of the organization of the matter are not able to become real predecessors of the plans of technical progress, and especially the plans of production. But without this the goals of the planning of scientific and technical progress "are eroded," it is subjected to chance occurrences which frequently dilute the role of scientific and technical progress in production.

"What does the country need first of all?" The plans of the scientific and technical progress of sectors, enterprises and sectorial science should be formed under such a motto. But the more thorough planning and design study of the technical and technological tasks, which is supported by their intersectorial coordination and material, financial and credit supply, is required for this.

It is important for the scientific potential of country to serve the cause of the improvement of production. This is especially necessary as the drive for scientific and technical progress is becoming more and more critical and uncompromising on the world scale, on the level of the competition of the two world systems--socialism and capitalism. It requires the mobilization of the efforts of science and all the national economic units--sectors, associations and enterprises. The more objective orientation of the consciousness of economic personnel toward the basic units of scientific and technical progress, which are capable of pulling out the entire chain of the further development of social production, is needed. At present advanced production technologies are one of these units. The set of conditions of the raising of the production of specific products of labor to the level of the current requirements of mature socialism is based precisely on them. It would not be an exaggeration to say: advanced technologies constitute under present conditions the strategy of scientific and technical progress.

In the new technologies, and not simply in the operating production processes, it is important to include new equipment, including robots, and electronics, and in agriculture new strains of plants, which are more suited for unstable climatic conditions, as well as more productive breeds of livestock. Modern technologies will require the renovation and retooling of production. They have an internal power, which makes it possible to bring the updating of production to the forefront of the activity of production organizers in the sector, at enterprises and associations. The difficulty is that this

requirement concerns not only the works, which complete the production of an item, but also all the members of the technological chain. Meanwhile the solution of intersectorial problems is complicated. Therefore the introduction of advanced technologies, just as the entire set of problems of the scientific and technical improvement of production, needs structural reinforcement. It includes the adaptation of internal production structures to the new technologies, the shortening of the lines of the transfer of raw materials, materials and blanks, which will make it possible to decrease their reserves in production, and the achievement of the greater coordination of the purchasing, processing and set-making works. Modern electronic means of recording and monitoring the movement of unfinished production are needed for this.

The structural changes, which are due to the technical improvement of production, cannot but affect the workplaces, their number, technical equipment and technological coordination, which is ensured by organized information about the progress of production operations, the quality of the parts being machined and component parts, the occurrence of irregularities in the production rhythm, in short, information which directs the attention of not only the production organizer, but also every worker, who is employed in this process, to specific actions.

Owing to changes of this sort advanced technologies create a stimulus for the improvement of the quality of labor and its content, the elimination of manual operations and, consequently, the increase of the skills of the worker.

It is impossible to overestimate this circumstance, if it is considered that scientific and technical progress is socially justified when it solves not only technical, but also economic problems: the decrease of the production cost, the saving of materials, fuel, energy, labor; as well as social problems: the increase of the creative nature of labor, the improvement of its conditions, the elimination of difficult, monotonous labor and so forth. All these difficult problems are being solved by means of new technologies. Therefore the introduction of advanced technologies is the business of not only sectorial science and such formations as scientific production associations. They cannot but become the subject of both economic and organizational, political and economic measures. The consistent organization of the introduction of advanced technologies and the updating of equipment, which conforms to them, are becoming especially urgent, because at a number of enterprises they are "dealing the final blow" to old equipment and by means of labor-consuming repair are with difficulty keeping it in working condition, freezing the backward technologies which check the decrease of material and manpower expenditures. This is concealed harm which society bears, paying with the slowing of the increase of labor productivity and production efficiency.

In this connection the question of the tactical line in the area of the technical improvement of production arises. Economic thought and the practice of management formulated convincing conclusions about the leading role of renovation and retooling in the technical improvement of production. Here it is frequently emphasized that renovation costs society less than the construction of new enterprises. This is an argument which it is impossible

to ignore, although renovation is carried out not always and not in each specific case with the least expenditures of physical assets and time.

But not only the resource-saving, but also the even larger-scale function of renovation is important for the economy. Without renovation it is impossible to solve the problem of THE ADAPTATION OF THE NATIONAL ECONOMY TO THE ASSIMILATION OF SCIENTIFIC AND TECHNICAL INNOVATIONS [in boldface]. But this is a problem of a strategic nature. It by right lays claim to the leading place in the plans of scientific and technical progress of the immediate period. Technical progress does not sweep aside operating production, it results from its contradictions, which express the new needs, but it dooms it to obsolescence and creates the means for updating. Renovation makes it possible to use these means. Therefore the prospect of economic development to a significant extent is governed by the possibilities of society to realize the potential resource of renovation--its skillful organization and the setting up of financial and material supply. The role of plans in the solution of this problem is obvious. But they are being used far from completely.

The plan makes it possible to vary the tasks of renovation, but here it is important to subordinate it not simply to the technical updating of some enterprise, sector or subsector or another, but to the meeting of a specific social need, and first of all to the obtaining of a specific product--of higher quality, with fewer material expenditures. The renovation of machine building plants, which ensure the success of technical progress, as well as rail transport--as a whole and on the busiest lines--should become a subject of special attention.

It is advisable to discuss the versions of the renovation of production at authoritative practical science conferences and to study them at scientific and planning centers, so that the directions and specific objects of renovation--what enterprises, at what time, for what purposes, for the sake of what items--would be specified with the greatest soundness for the period being planned. And for this the necessary conditions should be created for production, keeping in mind the quicker assimilation of the new product and the removal from the line of the obsolete product. It is to the country's disadvantage to prolong for many years the development of a new model of some machine or another and another item and, in this connection, the renovation of the enterprise. The losses from such delays in the end affect the efficiency of the national economy and the meeting of the needs of the people. If renovation is not moved now to the front line of technical transformations in the national economy, the increase of labor productivity in many sectors of the national economy, as well as the increase of product quality with the decrease of material expenditures will become problematic.

A specific orientation of the economic thinking of economic personnel and the accumulation of knowledge as a motive factor of scientific and technical progress are necessary for the solution of these problems. Advanced knowledge is incompatible with a technical lag, with conciliatoriness toward negative phenomena.

In other words, a turn in the psychological mood of personnel in favor of the renovation of production and other directions of scientific and technical progress is needed. The problem of renovation can be successfully solved only with consideration of the interaction of all its factors.

The technical improvement of production is not only progress, but also the breakup of what is obsolete (technologies, production structures, traditions). But every breakup does not occur smoothly and is accompanied by additional costs--not only material, but also moral. Therefore a substantial role in the solution of the problems of scientific and technical progress belongs to public consciousness and the political readiness of personnel for their perception as a natural necessity and for systematic implementation.

In its content scientific and technical progress is qualitative changes of the productive forces, that is, this is a material process. It includes, in addition to renovation, the retooling and expansion of enterprises and new construction and presumes the necessary material resources and the orientation of socialist expanded reproduction toward the replenishment of the accumulation fund as a source of the financing of the introduction of advanced technologies and other achievements of science and technology and advanced know-how.

However, in recent 5-year periods a decrease of the rate of accumulation, and particularly production accumulation, has occurred. The increase of unfinished construction, as a result of which by the early 1980's a significant portion of our national income was frozen in carryover projects, affected this phenomenon. The inadequacy of the political economic substantiation of practical actions also had an effect. The point of view that any increase of capital investments is an extensive phenomenon, was current at one time. Such an interpretation can disorient practice, since the essence of the problem is how resources are used. If they are invested in old equipment and in the reproduction of a technology which is already being used, this is an extensive means of development. If the assets are channeled into technical progress, into the development of new technology and promising, highly productive equipment, which conforms to it, this is the intensification of production. It is impracticable without scientific and technical progress and, consequently, without capital investments and without accumulation.

Production accumulations are the material motive force of technical progress. Therefore it is difficult to combine a broad program of the technical updating of the production system with the decrease of the rate of accumulation. The calculations, which were based on data published by the USSR Central Statistical Administration, show that in 1970 it came to 29.5 percent, in 1975--26.6 percent, in 1980--23.9 percent, in 1981--23.6 percent and in 1983--26.8 percent.[4]

The solution of this important problem of the economic development of the country stems from the need for the support of the key positions of scientific and technical progress in political economy and the practice of management. But, obviously, one should also not absolutize the economic role of the rate of accumulation. At one time it was very great, but the problems of the development of scientific and technical progress remained no less burning,

while the increase of the accumulation fund came up against large carryover amounts of unfinished construction. The traditional approach to the formation of the structure of capital investments was reflected in this. Given the limited capacities of the construction complex the emphasis was placed primarily on new construction, the time of which frequently exceeded the standard period, which caused the obsolescence of the works being newly put into operation. These phenomena were complicated by the delayed assimilation of the objects being newly put into operation, and while the assets were frozen in unfinished construction projects, the obsolescence of the fixed capital of operating production occurred and the possibilities of the updating and retooling of production were limited. The urgency of the expansion of renovation, the assignment to it of a truly decisive place in the plans of economic and social development and its subordination to the extensive introduction of advanced technologies is merely confirmed by this fact.

But the improvement of technologies, their development and dissemination are also not an end in themselves. It is advisable to channel capital investments into some new technologies or others, bearing in mind the meeting of the needs of society for a specific product (service). For example, it might be a question not simply of the development of light industry as a whole, but of the solution in the shortest possible time at a modern technology level of the problem of footwear, having ensured its high quality and esthetic properties.

Such an approach increases the responsibility of sectors for the meeting of needs and halts the dispersal of resources for uncoordinated organizational and technical measures. The introduction of individual machines, robots and even machine complexes and automatic lines yields specific results, but is insignificant in the meeting of the needs of society and does not cause significant changes in the level of labor productivity.

Such a radical change in the policy of capital investments is assuming particular importance under the conditions of highly concentrated production. Large associations and enterprises, which make up slightly more than 13 percent[5] of the number of enterprises and associations, produce more than two-thirds of the industrial output (according to the data of the grouping for 1979, which was published by the USSR Central Statistical Administration). This means that the tasks of the technical updating of the production of industrial output are governed mainly by the group of large enterprises. The planning of renovation and other forms of the technical improvement of production at such enterprises lends itself to accurate checking. But the questions of the scientific and technical progress additionally need it, they cannot be depersonalized in the sectorial management structure. The activity of the technical and other administrations of ministries should be focused on the implementation of the renovation and retooling of enterprises and the assimilation of new technologies.

But still the question of the role of the collective of the enterprise (association) in the solution of the problems of the technical improvement of production is the basic one. The success of any matter, which applies to production, is achieved at the enterprise. Therefore it is important how the adaptability of an enterprise to innovations, which are designed for the improvement of items, machines and equipment, is ensured. Ministries are

obliged to proceed from this fact in the approach to the formation of the conditions for the development of technical progress and the dissemination of innovations in the sector, especially at large enterprises, which are called upon to head the movement for the technical updating of the production system and the products of industry.

Here it is necessary to maintain the spirit of socialist management (on the basis of cooperation and mutual assistance) in the assimilation of innovations, while avoiding the increase of economic isolation and the opposition to the interests of one collective to another and of collective and statewide interests.

In this connection, on the one hand, the formation of the necessary political atmosphere at the enterprise and in the sector in favor of scientific and technical progress, in case of which all the possibilities of the use of assets for the updating of technologies and equipment would be weighed, a movement for the conversion of the plant into an enterprise of advanced (progressive) technology would be launched and the corresponding appraisals of the activity of the collective, the party, trade union and Komsomol organization would be formulated, and, on the other, the adaptation of the management structure to the solution of the problems, which are so complicated and important for the economic and social development of the country, will be necessary.

FOOTNOTES

1. K. U. Chernenko, "Na uroven' trebovaniy razvitogo sotsializma" [To the Level of the Requirements of Mature Socialism], Moscow, Politizdat, 1984, p 6.

2. K. Marx and F. Engels, "Soch." [Works], Vol 23, p 47.

3. K. Marx and F. Engels, "Soch.," Vol 25, Part I, pp 90, 91.

4. See "Narodnoye khozyaystvo SSSR v 1983 g." [The USSR National Economy in 1983], Moscow, "Finansy i statistika", 1984, p 409.

5. See "Narodnoye khozyaystvo SSSR v 1980 g." [The USSR National Economy in 1980], Moscow, "Finansy i statistika", 1981, p 151.

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GENERAL

KAZAKH EARTH SCIENCES ACHIEVEMENTS

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 12, Dec 84 pp 5-7

[Article: "On the Work of the Scientific Institutes of the Earth Sciences Department on the Implementation of the Decree of the CPSU Central Committee and the USSR Council of Ministers on the Acceleration of Scientific and Technical Progress in the National Economy"]

[Text] The presidium notes that the scientific institutions of the Earth Sciences Department have done definite work on the implementation of the decree of the session of the General Assembly of the Kazakh SSR Academy of Sciences of 15 December 1983 "On the Tasks of the Scientists of the Kazakh SSR Academy of Sciences on the Fulfillment of the Decree of the CPSU Central Committee and the USSR Council of Ministers 'On Measures on the Acceleration of Scientific and Technical Progress in the National Economy'" and the corresponding decree of the Central Committee of the Communist Party of Kazakhstan and the Kazakh SSR Council of Ministers.

The collectives of the scientific institutions have formulated specific measures, which envisage the further development of basic and applied research, participation in the elaboration of priority comprehensive scientific and technical programs, the broadening and strengthening of creative ties with production and the increase of the number of works being introduced.

In 3 years of the 11th Five-Year Plan the institutes of the department introduced more than 180 suggestions and recommendations with a total economic impact of 56 million rubles. The introduction of 47 works is envisaged in conformity with the plan of practical implementation for 1984. To date the introduction of 15 works with an total economic impact of 3.6 million rubles has been completed.

The elaboration of the theme "The Geological and Economic Evaluation of the Resources of Agronomic Ores of Southeastern Kazakhstan, Their Use and Influence on the Environment" is being carried out at the Institute of Geological Sciences imeni K. I. Satpayev. The research on the evaluation of the prospects of the development of the phosphorites of Malyy Karatau is being continued. The early completion of the theme on the study of the distribution

of the isotope osmium-187 and rhenium-containing ores and the transfer of the results for introduction to production is envisaged.

The Institute of Mining is successfully introducing at the mines of nonferrous metallurgy of Kazakhstan new advanced mining systems with the filling of the worked out area and the use of self-propelled equipment under difficult geological mining conditions.

The Institute of Hydrogeology and Hydrophysics is working on the fulfillment of the assignments on the USSR Food Program and the most complete use of the resources of ground waters for industrial and agricultural water supply, the irrigation of lands and the flooding of pastures. Research is being conducted on the study of the hydrogeological conditions and the modeling of natural processes at the Karatau-Dzhambul Territorial Production Complex and on the substantiation of the industrial development of the resources of thermal ground waters for thermal power supply.

The Institute of Seismology has developed a method and has given recommendations on the drawing up of maps of the detailed division into seismic areas for the seismically active regions of the Bartogayskiy Reservoir. The industrial tests of the method of predicting the outburst danger of coal seams according to the acoustic aftereffect of the massif were continued at the Mine imeni V. I. Lenin of the Karaganda Coal Association. The mine tests of the developed AIS-5 apparatus were begun.

The Institute of Geography is working on the evaluation of the avalanche danger of alpine regions of Central Asia and Kazakhstan. Recommendations on the maintenance of the optimum conditions of irrigation and drainage in the rice fields of the Akdalinskiy Massif were turned over to the Kazakh Institute of Water Resources of the USSR Ministry of Land Reclamation and Water Resources.

In strengthening the creative ties with production, the institutes of the department annually conclude about 100 contracts for a total amount of approximately 2.5 million rubles.

The Institute of Mining is successfully using the test sections, which are being made available by enterprises of ferrous and nonferrous metallurgy and the coal industry, for the performance of pilot industrial operations and the introduction of completed scientific research. Thus, the introduction of continuous sublevel breast excavation with filling and the use of self-propelled equipment was continued at the test section of the Tishinskiy Mine. In all 65,000 tons of ore were mined with an economic impact of 1.8 million rubles. A comprehensive program of scientific research and experimental design work on the theme "The Development of Mining Machines With Electric Drive" for 1984-1987 was formulated at the institute jointly with the Kazakh SSR Ministry of Nonferrous Metallurgy.

The structure of the scientific institutions of the department is being revised for the elimination of inefficient, as well as minor and duplicate themes.

Along with definite successes difficulties and shortcomings exist in the work of the scientific institutions of the department. The basic obstacle in the way of the implementation of scientific achievements is the absence at the scientific institutions of their own experimental base. The absence of operations, which are included in the plan of the economic and social development of the republic according to the section of introduction, is a serious shortcoming in the work of the institutes. The majority of themes are concluded with the drawing up of a report without further practical implementation. In 1983 the number of recommendations, which were adopted by production, and the economic impact from their introduction decreased. The number of received certificates of authorship is also decreasing.

The Presidium of the Kazakh SSR Academy of Sciences resolved to take note of the information on the activity of the scientific institutions of the Earth Sciences Department on the implementation of measures which are aimed at the acceleration of scientific and technical progress.

The presidium obliged the buro and the scientific institutions of the department:

--to ensure the further increase of the efficiency and quality of scientific research work in light of the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy";

--to submit annually on the set date to the presidium highly effective recommendations, which have been submitted for approval to ministries and departments, for inclusion in the plan of the economic and social development of the republic;

--to take effective steps on eliminating the shortcomings which were noted in the decree of the Presidium of the Kazakh SSR Academy of Sciences on the activity of the scientific institutions of the Earth Sciences Department for 1983.

The presidium directed the attention of the Earth Sciences Department to the trend toward the decrease in the department of the number of received certificates of authorship, as well as the economic impact from introduction.

The Presidium of the Kazakh SSR Academy of Sciences also adopted decrees on a number of other questions, in particular:

--on additional measures on the increase of the efficiency of the use of mineral raw materials in the national economy;

--on the observance of labor legislation and discipline in the scientific institutions and organizations of the Kazakh SSR Academy of Sciences;

--on the state registration of scientific research work at the institutions of the Kazakh SSR Academy of Sciences.

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END